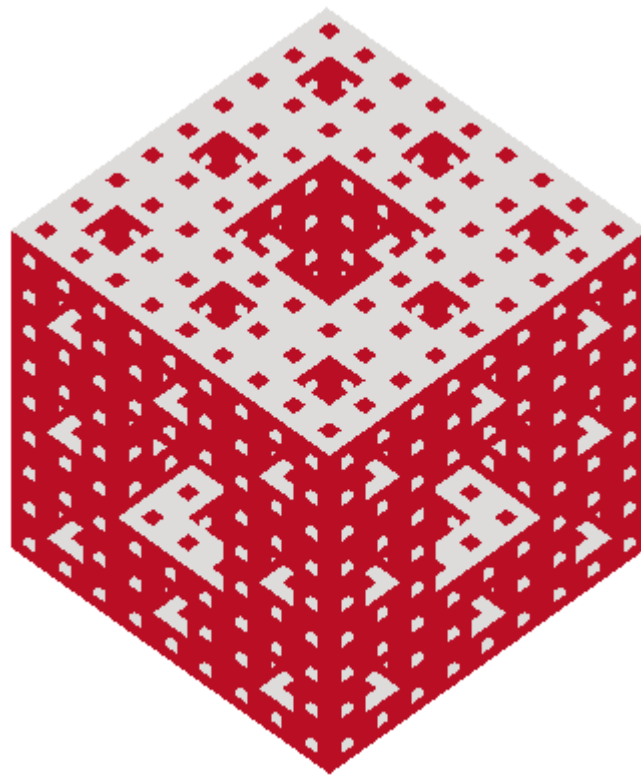


**Undergraduate Handbook
B.S. in Applied Mathematics
B.S.+M.S. in Applied Mathematics**



Department of Applied Mathematics
**([http://science.iit.edu/applied-
mathematics/](http://science.iit.edu/applied-mathematics/))**

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Department of Applied Mathematics

(Fall 2015)

I. General Information

1.1 Introduction

This handbook is intended to be a useful resource for all Applied Mathematics (AM) undergraduates and their advisors and mentors. The aim of this document is to provide a dynamic source of information relating to the changes and updates in the AM undergraduate curriculum.

Illinois Institute of Technology was originally founded in 1940, when the Armour Institute (est. 1893) merged with the Lewis Institute (est. 1895). Ever since the inception of this university, degree programs in Mathematics have been awarded at both the undergraduate and the graduate level. The Applied Mathematics department at IIT was formed relatively recently – in the year 1998. The first undergraduates admitted to the AM program began their studies in the year 2000.

Since the undergraduate advising guidelines contained herein are subject to frequent changes, please be certain to always refer to the most current advising publication whenever specific questions arise regarding the undergraduate AM curriculum.

The AM Department takes academic advising very seriously and considers the conscientious, careful advising and mentoring of its majors to be crucial to both their success at the undergraduate level as well as to their future planning for professional or academic careers. Therefore, it is important for all AM advisors and mentors to make time available for sessions with all of their advisees during every advance registration period, and also during each week preceding the start of a new academic term. Academic advisory sessions may be formally scheduled by the student or they may occur without appointment during the advisor's posted office hours. Advising is also frequently done via email. The advance registration period is the month of April for the summer and fall terms, and it is the month of November for the spring semester. If an advisor is on leave or out of the office for some reason, then arrangements must be made through the Department Coordinator for another advisor to assist in the advising process.

1.2 Administration of the AM Undergraduate Programs

The AM faculty is responsible for creating, maintaining and implementing the major curriculum for the Bachelor of Science Degree in Applied Mathematics. A committee of AM faculty, called the Undergraduate Studies Committee (UGSC), is granted authority to assess student performance, recommend program changes, approve of course substitutions and to award credit for special projects. IIT's administrative departments, such as the Office of Undergraduate Academic Affairs (ugaa@iit.edu), may consult with the UGSC when deciding issues which have implications for the undergraduate curriculum in mathematics. Any changes or deviations to the AM Undergraduate Advising Guidelines and its policies must be approved by the UGSC. The chair of this committee is the associate chair of the department. All other members of the committee

serve one-year appointments while the department chair serves as ex-officio member. The department chair and associate chair have executive authority in the day-to-day administration of the undergraduate AM programs.

1.3 Key Contacts

Fred Hickernell – Department Chair, hickernell@iit.edu

Greg Fasshauer – Associate Chair, for advising issues, fasshauer@iit.edu

David Maslanka – For questions related to course scheduling, maslanka@iit.edu

Fred Weening – For problems with closed courses or permit issues, fweening@iit.edu

Gladys Collins – Department Coordinator, collinsg@iit.edu

II. Programs of Study

2.1 Definition of Program of Study

It is especially important for both the advisor and the student to be aware of which edition of the IIT Bulletin (i.e., the university’s undergraduate program catalog) will serve as that student’s “official bulletin.” The degree requirements specified in that particular bulletin are the ones which will form the basis for the contract between the student and the university.

The official bulletin for students who began their careers at IIT as first year freshmen is always that which was current upon their initial enrollment at the university. The following table lists which bulletin applies to which entry semester.

Freshman semester	Undergraduate Bulletin
Fall 2001–Spring 2004	green
Fall 2004–Spring 2006	dark gray
Fall 2006–Spring 2008	red
Fall 2008–Spring 2010	red and gray
Fall 2010–Spring 2012	white
Fall 2012–Spring 2014	dark blue with color image
since Fall 2014	black with color image

The official bulletin for transfer students is determined by the Office of Undergraduate Academic Affairs (ugaa@iit.edu) and is indicated on their Transfer Credit Evaluation form.

It is extremely important for each student to follow precisely all of the provisions that are detailed in his/her official bulletin in order to make certain that all requirements for graduation are met. Since some degree requirements have changed over the years, students who reference two different editions of the bulletin may not necessarily fulfill their specific graduation requirements.

In the rare occurrence of a programming change that has implications for current AM majors, the department’s advisors or associate chair will convey the relevant news to all of the affected students as soon as possible and will also post this information on the department web site.

The Office of Undergraduate Academic Affairs (ugaa@iit.edu) will audit a student's program of study based solely on his/her official bulletin and those specific changes authorized by the UGSC. A student may request such an audit any time after having accumulated about 60 credit hours of course work.

2.2 Faculty Advising Information

All undergraduate students have advising requirements. Each semester a new so-called "alternate PIN" is provided to the student by his or her advisor. Once the student has consulted with his/her advisor about next semester's schedule of classes, the advisor passes the alternate PIN on to the student who is then able to register for classes through the MyIIT portal. Registration changes (such as dropping or adding classes) can be made in the same manner using the current semester's alternate PIN.

Students should therefore remember their alternate PIN for the entire semester.

Advisors obtain the alternate PIN via the Banner channels or the UG Academic Affairs Faculty channel in MyIIT.

2.3 Semester Plans

An eight semester program of study very similar to that outlined in section 2.4 below can be found in each of the IIT Bulletins currently in use. This program plan should be viewed only as a general guide toward fulfilling all the degree requirements in a reasonable and timely manner. Keep in mind that the actual semester that a particular AM major enrolls in any specified course may deviate from this plan due to the individual's specific circumstances and needs. For example, a student may be ahead of the plan because of earned AP credits, transfer credits, or summer school credits. The online DegreeWorks system (accessible through the MyIIT portal) should be used to devise a personalized program of study. The Curriculum Worksheet found in the Appendix may also be used for this purpose.

2.4 Sample Curriculum for Students Admitted in Fall 2015 or later

All Applied Mathematics majors are required to take certain core mathematics courses, six MATH electives, as well as certain general education (humanities, social sciences, IPROs), computer science, and natural science/engineering courses, along with a minor, and some free electives.

The list of core MATH courses is given by

- MATH 100, 151, 152, 230, 251, 252, 332, 350, 380, 400, 410/430/431/454, 475, all of which are featured in the sample curriculum below.

Students and advisors should note that the sample curriculum is just that – a sample. Most students will likely end up taking a slightly altered curriculum, depending on, e.g., the amount of AP or transfer credit, or just personal preference in taking courses.

The remainder of this document contains many more details that will help put together a curriculum that fits the student's individual needs and preferences. For example, Section 9.1 lists prerequisite dependencies and Section 9.2 provides a table of planned future course offerings. The tools discussed in Section 2.5 should also prove helpful in this respect.

First semester	Second semester	Third semester	Fourth semester
MATH 100	3 MATH 152	5 MATH 251	4 MATH 252
MATH 151	5 MATH 230	3 MATH 332	3 MATH 350
CS 104	2 CS 115	2 Minor subject	3 Minor subject
Science elective	3 PHYS 123	4 Science elective	3 Science elective
HUM 20x	3 Hum. or Soc. Sci. elect.	3 Hum. or Soc. Sci. elect.	3 Hum. or Soc. Sci. elect.
16	17	16	16
Fifth semester	Sixth semester	Seventh semester	Eighth semester
MATH 430 or 431*	3 MATH 380	3 MATH 400	3 Appl. Math. elective
MATH 475	3 MATH 410 or 454*	3 Appl. Math. Elective	3 Appl. Math. elective
Appl. Math. elective	3 Appl. Math. elective	3 Minor subject	3 IPRO 497
Minor subject	3 Minor subject	3 Hum. or Soc. Sci. elect.	3 Hum. or Soc. Sci. elect.
Hum. or Soc. Sci. elect.	3 IPRO 397	3 Free elective	3 Free elective
Free elective	3		
18	15	15	15
			Total credit hours
			128

*AM majors are required to take one of MATH 410, 430, 431 or 454. MATH 430 and 431 are offered only during fall semesters, MATH 410 and 454 in the spring. If a student chooses to take only one of these courses, then the other slot marked with an asterisk is to be interpreted as an Appl. Math. Elective.

2.5 Planning Out the Curriculum

As mentioned above, students are strongly encouraged to utilize the DegreeWorks software found on the Academic tab of their MyIIT portal to plan their curriculum. DegreeWorks allows the student to explore “what-if” scenarios such as adding a minor, a specialization, or even a second major (see sections V-VII below). The “Planner” function in DegreeWorks provides students and advisors with a simple tool in a location easily accessible to both of them for planning out future semesters.

Alternatively, students may choose to record their course credits on the Curriculum Worksheet included in the Appendix of this handbook.

Because the program of study requirements for each undergraduate student are dependent upon the semester and year in which he/she initially matriculated, it is highly recommended that both the student and the advisor either use DegreeWorks or maintain an up-to-date copy of the Curriculum worksheet for their personal records. Note that the worksheet includes further details regarding the rules and limitations of course selections. The same rules are also implemented in DegreeWorks.

2.6 Course Substitutions

Course substitutions may be allowed if *all* of the following conditions apply:

- A required course is neither currently being offered nor projected to be offered before the student’s anticipated graduation, nor is it available for independent study.
- A substitute course is available that satisfies the objectives of the student’s program of study.
- The Core Curriculum Requirements of the university are satisfied by the resulting program of study once the substitution has been made.
- The substitution is approved by the advisor and the UGSC, and documentation of this approval is sent to Undergraduate Academic Affairs (ugaa@iit.edu).

2.7 Students not on Plan

As previously noted, an AM major may have earned additional credits to place him/her ahead of the program of study plan described in the bulletin. In this case the student may be eligible for a co-terminal BS/MS program (see Section 7.2 below).

It may also happen that an AM major falls behind the program plan in a given semester. In either case, DegreeWorks or the Program Worksheet along with the Four-Year Course Plan included below should serve as a guide for the student and advisor in the selection of appropriate courses each term.

2.8 Students Performing Poorly

IIT requires a minimum cumulative grade point average of 2.00 and a minimum grade point average of 2.00 in the student's major department courses. Students who do not maintain these averages will be placed on academic probation and **will not be able to graduate if these minimum standards are not fulfilled**. For more details see the IIT student handbook (available online at http://www.iit.edu/student_affairs/handbook/). Attention is called to the fact that Applied Mathematics students whose major grade point averages are less than 2.30 at the end of any academic term may, at the discretion of the department, be refused permission to continue the program of study in this field.

III. Course Projections/Scheduling

A Four-Year Course Plan is included in Section IX of this handbook to provide students and advisors with some insight into when every 100 through 400-level AM class will be taught during the upcoming semesters. *These projections are tentative in nature and are subject to change* but they should clearly indicate to the reader the relative frequency and the periodicity with which the department plans to offer each math class. These projections are particularly important when planning a detailed, personalized program of study.

Since upper-level AM courses often require prerequisite knowledge gained from lower-level course work, the proper sequencing of major courses is critical to the student's ability to successfully complete the degree requirements in eight semesters of work. Therefore, to avoid a delay in graduation, students should make every effort to be "on semester" during their sixth, seventh, and eighth semesters of study. This is because many required upper-division AM courses are currently taught only once per academic year: during the "on semester" as indicated in the table in Section IX.

The schedule of classes taught each semester by the AM department is set by the associate chair and the chair of the department. The final version of which is due for submission to the Office of the Registrar by mid-February for the summer and fall terms and by mid-September for the spring term. Advisors are encouraged to inform the associate chair in advance of these due dates whenever an advisee has a specialized scheduling need. Similarly, any request from a student for a special course offering should be formally made to the associate chair *one semester in advance*. Every attempt will be made to accommodate these special requests – if done so as described above. However, please know that it is extremely difficult for the department heads to make any changes in the course schedule once it has been finalized and submitted to the Registrar.

IV. Electives

4.1 Applied Mathematics Electives

Any applied mathematics course at the 300-level or higher (including MATH 491 and graduate MATH courses) except MATH 333, 374, 425, 426, 474 and 525 may be used as an applied mathematics elective. Courses from other programs may not be used as applied mathematics electives. An exception to this rule may be granted only for students pursuing a double major in a related field (such as computer science, physics or engineering).

4.2 Humanities and Social Science Electives

9 credit hours each of Humanities and Social Science Electives are required as part of IIT's Core Curriculum Requirements. Check each course description in the current Schedule of Classes to ensure that it is marked as a valid humanities (**H**) or social sciences (**S**) elective. In particular, at least 6 hours are required at the 300-level for both humanities and for social science courses (only 3 hours of upper-level social science coursework are required for students entering before fall 2015). Moreover, for social sciences, at least 6 hours are required in one field and at least 2 different fields need to be covered. A total of 21 hours are required for humanities and social sciences combined (i.e., students are required to take one humanities *or* social science course *in addition to those mentioned above*). The current Schedule of Classes takes authority over the Bulletin in this regard. Foreign language classes can be taken to fulfill the Humanities requirements as long as they are at the 200-level or above and marked with an (**H**). Certain courses taken at Shimer College or VanderCook College of Music may qualify as humanities or social science electives (see <https://admissions.iit.edu/undergraduate/programs/classes-vandercook-college-music-and-shimer-college> or <https://web.iit.edu/ugaa/joint-programs> for additional information).

4.3 Communications Courses

At IIT, communications (**C**) courses are distributed across the curriculum, and as such students should take care in the selection of electives so that the (**C**) course component of IIT's Core Curriculum Requirements is satisfied. Students must complete a minimum of 36 (**C**) credit hours. Of these, at least 12 hours must be in MATH (currently to be chosen from MATH 100, 151, 152, 230, 350, 380, 430, 431, 454, 476, 484, 486, 487, 491 and 497).

4.4 Free Electives

The B.S. in applied mathematics allows for 9 hours of free electives. Free elective course material must not substantially duplicate material from other courses in the student's program. The UGSC reviews all proposals for Special Projects or Undergraduate Research whether it is to satisfy a Free Elective requirement or substitute for a required course. A third IPRO can count as a Free Elective for all students except those with a freshman standing. However, an IPRO cannot count as both a free elective and either IPRO I or IPRO II. Students are responsible for satisfaction of any course prerequisites for a free elective before taking the course. Some courses taken for a minor can also count as a free elective (see Minors section). Certain courses taken at VanderCook College of Music or Shimer College can count as free electives. Some of those courses may even qualify as humanities or social science courses. Please see <https://admissions.iit.edu/undergraduate/programs/classes-vandercook-college-music->

[and-shimer-college](#) or <https://web.iit.edu/ugaa/joint-programs>, or contact the Office of Undergraduate Academic Affairs (ugaa@iit.edu) for further information.

V. Minors

5.1 Minors in General

Every student in the applied mathematics B.S. degree program is required to declare an approved minor. Usually a minor consists of 5 related courses from departments other than applied mathematics. Please refer to the appropriate bulletin for detailed information as well as for the list of available minors (currently pp. 172-175, [https://web.iit.edu/sites/web/files/departments/academic-affairs/Undergraduate Academic Affairs/pdfs/ugbulletin14-16.pdf](https://web.iit.edu/sites/web/files/departments/academic-affairs/Undergraduate_Academic_Affairs/pdfs/ugbulletin14-16.pdf)). There is no requirement for students to declare a minor until they fill out an application for graduation form. However, if students wish to receive an accurate audit of their academic programs (see Miscellaneous, Section VIII) then they need to notify the Office of Undergraduate Academic Affairs (ugaa@iit.edu) of their minor (see Forms, Section IX). The unofficial DegreeWorks audit will also be inaccurate if the minor has not been declared. A student must petition the UGSC for permission to declare a minor not already listed as approved.

5.2 STEM Education Minor

IIT's College of Science offers a program that will prepare students for the Illinois State Licensure in Secondary Mathematics (grades 6-12) and Secondary Science: Biology, Chemistry, or Physics (grades 6-12). The 24 credit hour **STEM education minor** consists of the following courses:

- MSED 200 (Analysis of Classrooms, offered in fall semesters),
- MSED 250 (Middle and Secondary Curriculum, spring),
- MSED 300 (Instructional Methods /Strategies I, fall),
- MSED 320 (Inquiry and Problem Solving in Mathematics and Science, fall),
- MSED 400 (Instructional Methods /Strategies II, spring),
- MSED 350 (Advanced Methods for Inclusive Instruction, fall),
- MSED 450 (Professional Internship, spring).

Please note that MSED 450 is a 6-credit course focused on student teaching. In order to satisfy financial aid requirements it is frequently taken concurrently with MSED 497 (Special Topics). A student enrolled in MSED 450 will spend the entire semester teaching at a local area school under the supervision of a classroom teacher and university supervisor. Therefore, enrollment in MSED 450 (and 497) generally makes the student unavailable for enrollment in any concurrent weekday classes at IIT.

For guidance in choosing MATH elective courses to complement this minor, see the Specialization in Math Education below.

In order to fit this minor within the usual 128 credits required for the B.S. in Applied Mathematics degree a student will have to dedicate all 9 free elective credits to the STEM education minor.

VI. Specializations

In addition to the general B.S. degree in Applied Mathematics, the department offers six special five-course sequences that may be used as a guide for the selection of **mathematics electives** and will prepare the student for a career in

- business/finance,
- industrial research, or
- graduate school.

Choosing any of the following specializations is **optional**. If students wish to receive an accurate audit of their academic programs (see Miscellaneous, Section VIII) then they need to notify the Office of Undergraduate Academic Affairs (ugaa@iit.edu) of their choice of specialization(s) (see Forms, Section IX). In addition to speaking with their academic advisor, students should also consult with the program advisors of their chosen specialization as they can act as additional mentors.

6.1 Specialization in Mathematical Finance

Program advisor: T. Bielecki

Students who choose this specialization may qualify for admission to the Master of Mathematical Finance program (see http://www.iit.edu/mathematical_finance/) – a collaborative program between the Stuart School of Business and the Applied Mathematics Department. The objective of the MMF program is to provide individuals interested in pursuing careers in the finance industry with advanced education in theoretical, computational and business aspects of relevant quantitative methodologies.

Students are required to earn a **business minor** or an **entrepreneurship minor** (see the IIT Undergraduate Bulletin for details).

Students need to complete

- MATH 475 (Probability),
- MATH 476 (Statistics),
- MATH 478 (Numerical Methods for Differential Equations),
- MATH 481 (Introduction to Stochastic Processes),
- MATH 485 (Introduction to Mathematical Finance).

MATH 475 is required for all applied mathematics majors, the other four courses count toward MATH electives.

Closely related courses which are recommended as additional electives include

- MATH 461 (Fourier Series and Boundary Value Problems),
- MATH 477 (Numerical Linear Algebra),
- MATH 483 (Design and Analysis of Experiments),
- MATH 484 (Regression and Forecasting),
- MATH 486 (Mathematical Modeling),
- MATH 489 (Partial Differential Equations).

6.2 Specialization in Math Education

Program advisor: G. Fasshauer

Students interested in K-12 mathematics education should (major in Applied Mathematics and) complete a minor in STEM Education (described in Section 5.2). Optionally, students may complete 5 of the following courses, leading to the additional specialization in math education:

- MATH 380 (Introduction to Mathematical Modeling),
- MATH 410 (Number Theory),
- MATH 420 (Geometry),

MATH 430 (Applied Algebra),
MATH 453 (Combinatorics),
MATH 454 (Graph Theory),
MATH 475 (Probability),
MATH 476 (Statistics),
MATH 486 (Mathematical Modeling).

MATH 380, one of MATH 410/430/431/454, and MATH 475 are required for all applied mathematics majors. The other two or three courses count toward MATH electives. Courses not chosen for the specialization are recommended as additional electives.

6.3 Specialization in Applied Analysis

Program advisor: J. Duan

Applied analysis is one of the foundations for interdisciplinary applied mathematics. The principles of analysis are applied to such areas as partial differential equations, dynamical systems and numerical analysis. The basic framework, concepts and techniques of modern mathematical analysis are essential for modeling, analysis and simulation of complicated phenomena in engineering and science.

Students need to complete

MATH 380 (Introduction to Mathematical Modeling),
MATH 400 (Real Analysis),
MATH 461 (Fourier Series and Boundary Value Problems),
MATH 488 (Ordinary Differential Equations and Dynamical Systems),
MATH 489 (Partial Differential Equations).

MATH 380 and 400 are required for all applied mathematics majors. The other three courses count toward MATH electives.

Closely related courses which are recommended as additional electives include

MATH 402 (Complex Analysis),
MATH 478 (Numerical Methods for Differential Equations),
MATH 486 (Mathematical Modeling).

Recommended minors include: physics, or one of the engineering minors.

6.4 Specialization in Computational Mathematics

Program advisor: X. Li

The use of computation/simulation as a third alternative to theory and experimentation is now common practice in many branches of science and engineering. Many scientific problems that were previously inaccessible have seen tremendous progress from the use of computation (e.g., many-body simulations in physics and chemistry, simulation of semi-conductors, etc.). Researchers and scientists in these areas must have a sound training in the fundamentals of computational mathematics and become proficient in the use and development of new algorithms and analytical techniques as they apply to modern computational environments.

Students need to complete

MATH 350 (Introduction to Computational Mathematics),

MATH 435 (Linear Optimization) or MATH 461 (Fourier Series and Boundary Value Problems),
MATH 476 (Statistics),
MATH 477 (Numerical Linear Algebra),
MATH 478 (Numerical Methods for Differential Equations).
MATH 350 is required for all applied mathematics majors. The other four courses count toward MATH electives.

Closely related courses which are recommended as additional electives include
MATH 435* (Linear Optimization),
MATH 431 (Computational Algebraic Geometry)
MATH 461* (Fourier Series and Boundary Value Problems),
MATH 486 (Mathematical Modeling),
MATH 488 (Ordinary Differential Equations and Dynamical Systems),
MATH 489 (Partial Differential Equations).

* Only if not already counted as a required course.

Recommended minors include: artificial intelligence, computational structures, or software engineering.

6.5 Specialization in Discrete Applied Mathematics

Program advisor: M. Pelsmajer

Discrete applied mathematics is a fairly young branch of mathematics and is concerned with using combinatorics, graph theory, optimization, and portions of theoretical computer science to attack problems in engineering as well as the hard and soft sciences.

Students need to complete

MATH 332 (Elementary Linear Algebra),
MATH 430 (Applied Algebra),
MATH 435 (Linear Optimization),
MATH 453 (Combinatorics),
MATH 454 (Graph Theory).

MATH 332 is required for all applied mathematics majors, and MATH 430 or 454 may be used to satisfy the discrete mathematics core requirement MATH 410/430/431/454. The other three courses count toward MATH electives.

Closely related courses which are recommended as additional electives include
MATH 410 (Number Theory),
MATH 431 (Computational Algebraic Geometry).

Recommended minors include: artificial intelligence, computational structures, or computer networking.

6.6 Specialization in Stochastics

Program advisor: I. Cialenco

Stochastics at IIT includes traditional statistics (the methods of data analysis and inference) and probability (the modeling of uncertainty and randomness). However, also included are other areas where stochastic methods have been becoming more important in

recent years such as stochastic processes, stochastic integration, stochastic dynamics, stochastic partial differential equations, probabilistic methods for analysis, mathematical finance, discrete mathematics, and computational methods for stochastic systems.

Students need to complete

MATH 475 (Probability),

MATH 476 (Statistics),

MATH 481 (Introduction to Stochastic Process),

MATH 485 (Introduction to Mathematical Finance),

MATH 488 (Ordinary Differential Equations and Dynamical Systems).

MATH 475 is required for all applied mathematics majors, the other four courses count toward MATH electives.

Closely related courses which are recommended as additional electives include

MATH 453 (Combinatorics),

MATH 483 (Design and Analysis of Experiments),

MATH 484 (Regression and Forecasting),

MATH 486 (Mathematical Modeling).

VII. Double Degrees

7.1 Two B.S. Degrees

While AM students frequently obtain a double degree in AM and PHYS, or AM and CS, other combinations are also possible. These double degrees can generally be obtained with one extra semester or two summer semesters of coursework if students make an appropriate selection of free electives. Students who enter with AP credit will need less additional time to complete the requirements. A student who wishes to receive a double degree must complete all the required courses for each major as listed in the appropriate bulletin. Note that the IIT requirement of a minimum of 15 additional credit hours of work for the second degree will be met for any of these combinations if the second major coincides with the declared AM minor. No additional Core Curriculum courses or IPROs are required. Required courses in one major may be used to satisfy electives in the second major. Students wishing to pursue double degrees must consult with the department's associate chair.

7.2 Co-Terminal B.S.-Master's Degrees in Applied Mathematics

A typical Master's degree requires two years after the B.S. degree. Students admitted into a co-terminal program may be able to reduce their time to a Master's degree by one year, and possibly even more with sufficient AP or transfer credits. Co-terminal combinations are attractive since credit sharing of up to 9 credits is allowed between the two degrees. Moreover, students maintain their undergraduate status and therefore may be able to maintain their undergraduate financial aid eligibility.

Currently, the following co-terminal combinations involving a B.S. in Applied Mathematics are available: M.S. in Applied Mathematics, M.S. in Computer Science, Master of Data Science, and Master of Computer Science. Detailed information about these programs (including a sample program of study) can be found on the College of Science website at <http://science.iit.edu/programs/undergraduate/co-terminal-degrees>. For general questions about co-terminal degrees at IIT you may consult

<http://admissions.iit.edu/graduate/apply/co-terminal-degrees>. You may also contact the associate chair (currently Prof. Greg Fasshauer, fasshauer@iit.edu) or the director of graduate studies (currently Prof. Xiaofan Li, lix@iit.edu).

VIII. Miscellaneous Information

8.1 Closed Courses

When a course enrollment capacity is reached, the course will become closed to other students. Students who take advantage of advance registration have a much better chance of avoiding such a situation. Whenever possible, the AM department will try (admission not guaranteed) to accommodate all students and admit them into a closed class using the following guidelines:

- There is a legitimate need to get into the closed section.
- There is enough physical space in the classroom.
- There is enough equipment to accommodate all students.
- The additional headcount will not create a burden to the instructor.

Admission to a closed section of a departmental course requires the approval of both the course instructor and the associate chair. Admission to a closed section of a course outside of the department requires the approval of that department. Before attempting to admit a student into a closed class, the advisor should make every effort to help the student construct an alternative schedule. Not wishing to take a class at a particular time or with a particular instructor is not a sufficient reason to get into a closed course. Every effort will be made to put those students with credible time conflicts into closed courses. Such students have priority.

A student wanting to be waitlisted for a closed course must do so through the myIIT portal. The system will offer the waiting list option if the CRN of a closed course is entered into the registration field.

More details on closed courses and waiting lists (including contact information for other departments at IIT) can be found at http://www.iit.edu/registrar/registration_tools/.

Please contact Fred Weening (fweening@iit.edu) if you have questions about closed MATH courses.

8.2 ROTC

The three ROTC programs are treated as minors. Each ROTC student has an ROTC advisor in his or her unit, and communication with that person can be helpful in resolving problems. The ROTC unit may require an AM signature on the student's "4-year plan", which advisors are authorized to provide after carefully checking the plan for AM requirements. ROTC courses do not count toward the maximum of 18 credit hours a student may carry (i.e., no course overload signature is needed from the Associate Dean of the College of Science). ROTC individual study programs are developed with the assistance of the associate chair. ROTC students are exempt from one IPRO requirement so long as they remain in the ROTC program. If a student drops out of the ROTC program for any reason, he or she is required to make up that IPRO.

8.3 Co-op Program

Students may seek permission to register for Co-op from the Career Management Center (<http://www.cdc.iit.edu/>) in Hermann Hall. Students interested in the co-op program should see the associate chair of the department for advice. Co-op experience does not count for academic credit, but students on co-op are considered to be in full-time status

for the duration of their co-op for student visa purposes (international students) and student loan purposes. Students receiving scholarships are not supported during a co-op semester unless they are also taking regular courses. Students receiving financial aid are recommended to consult with their financial aid advisor to determine if any special rules apply during their co-op. If a student wishes to take courses during a co-op, the maximum recommended course load is 6 credit hours (full time co-op) or 12 credit hours (part-time co-op).

8.4 Summer Research

More and more applied mathematics majors are interested in and participate in summer research projects. Such opportunities exist both at IIT and at other universities – often referred to as REUs (Research Experiences for Undergraduates). Information is available from IIT's Office of Undergraduate Research (http://www.iit.edu/research/undergraduate_research/), via the American Mathematical Society (<http://www.ams.org/programs/students/undergrad/emp-reu>), as well as from individual professors.

8.5 Internships

An internship is generally a full-time summer employment opportunity. Applications are available in the Career Management Center (<http://www.cmc.iit.edu/>). The Career Management Center sends applications to participating companies and administers the program.

8.6 Academic Audits

All students should request an academic audit in their junior year (after completing about 60 credit hours) from Undergraduate Academic Affairs (ugaa@iit.edu). The Minor and possible specialization needs to be noted on the Academic Program Audit Request form or via a DegreeWorks petition (see Forms, Section IX). Audits can be compared to curriculum worksheets and DegreeWorks to confirm accuracy.

8.7 Proficiency Exams

The Registrar's Office allows credit by examination for coursework obtained through outside experience. It is at the discretion of the department offering the specific course as to whether or not a proficiency exam will be granted on the subject matter. The Credit by Examination Form may be obtained in the Office of the Registrar, and a per-credit-hour fee is charged for each examination.

The Department of Applied Mathematics also offers a no-cost alternative to credit by examination. A student needs to pass a similar proficiency exam and – if successful – can have the course requirement waived (instead of receiving credit for it). This means that the student will have to up the number of waived credits with other, usually higher-level, MATH courses.

Proficiency exams in 100 or 200-level MATH courses for students entering IIT can be arranged at the start of their first semester at IIT. The exam is administered at the discretion of the Applied Mathematics UGSC.

8.8 Courses from Another School

To obtain credit for a course taken at another school, a student must submit a petition (see Forms section) describing the request and obtain approval before starting the course. This

process may take several weeks. The final 45 hours of course work must be completed in residence at IIT.

8.9 Study Abroad

Students wishing to spend time studying abroad should contact the International Center (<http://web.iit.edu/study-abroad>) for information on universities that maintain study abroad relationships with IIT. The application process should be initiated the year before the student wishes to study abroad. Students must verify their eligibility with their associate chair and the International Center.

8.10 Graduate Study

Students wishing to pursue advanced degrees at IIT are encouraged to contact the Director of Graduate Studies, Professor Xiaofan Li (lix@iit.edu). See also the co-terminal BS-MS degree information in Section 7.2 above.

8.11 Student Clubs

The SIAM Student Chapter at IIT is supported by the *Society for Industrial and Applied Mathematics* (SIAM). Through this student chapter any applied mathematics student can become a free member of SIAM. One of the benefits of SIAM membership is a discount rate on SIAM-published books and conference fees. The SIAM chapter organizes various academic and social events throughout the year. The website for the SIAM student chapter is <http://math.iit.edu/~siam>, and the current faculty advisors are Professors Hemanshu Kaul (kaul@math.iit.edu) and Shuwang Li (sli@math.iit.edu).

Similar to the SIAM Chapter, the Math Club promotes interest in the field of mathematics and provides fun and educational group activities – aimed primarily at undergraduate students – that promote logical thinking and mathematical challenges. Interested students should visit <http://science.iit.edu/applied-mathematics/resources/undergraduates/math-club> or join via the [Math Club HawkLink portal](#). The current faculty advisor is Dr. John Erickson (john.erickson@iit.edu).

The purpose of the Actuarial Science Club is to share experiences and knowledge related to actuarial science. The club meets irregularly and focusses mostly on preparation for actuarial exams. Interested students should contact the current president of the club, Xiaodong Zhang (xzhan118@hawk.iit.edu), or the current faculty advisor, Professor Fred Hickernell (hickernell@iit.edu).

8.12 Phone Numbers You Should Know

College of Science, Dean's Office	567-3800
Academic Resource Center (ARC)	567-5216
Career Management Center	567-6800
Disability Program	567-5744
Financial Aid Office	567-7219
Housing and Residential Services	567-5075
International Center	567-3680
One Stop	567-3810
Public Safety	808-6300
Registrar's Office	567-3100

Spiritual Life	567-3160
Student Accounting Office (Bursar)	567-3794
Student Affairs (Dean of Students)	567-3081
Student Center for Diversity and Inclusion	567-5250
Student Employment Office	567-5729
Student Health and Wellness Center	567-7550
Undergraduate Academic Affairs	567-3300

If in doubt, check the online IIT phone book at <http://phonebook.iit.edu>.

8.13 Advising Codes

Students registering for undergraduate research, special topics, or reading courses use the faculty advising code below in place of a course section number.

Adler	155	Kaul	189
Bielecki	160	Li, Shuwang	141
Choi	195	Li, Xiaofan	158
Cialenco	191	Lubin	150
Duan	133	Lyashenko	101
Ellis	188	Maslanka	186
Erickson	187	Pelsmajer	198
Fasshauer	159	Petrović	114
Gong	190	Tier	192
Hickernell	115	Weening	157
Kang	193	Xie	194

The advisor code for faculty with joint appointments in AM can be found by contacting their main departments: Reingold (CS), Nair and Rempfer (MMAE).

IX. Course Dependencies and Forms

9.1 Course Dependencies

The **required** AM courses have the following pre-requisites:

MATH 100 (Introduction to the Profession): none

MATH 151 (Calculus I): placement

MATH 152 (Calculus II): “C” or better in MATH 151 (or in MATH 149)

MATH 230 (Introduction to Discrete Mathematics): none

MATH 251 (Multivariate and Vector Calculus): MATH 152

MATH 252 (Introduction to Differential Equations): MATH 152

MATH 332 (Elementary Linear Algebra): MATH 251 (may be taken concurrently)

MATH 350 (Introduction to Computational Mathematics): MATH 251, CS 104 or 115,

MATH 252 (may be taken concurrently)

MATH 380 (Introduction to Mathematical Modeling): MATH 251, CS 104, MATH 252

(may be taken concurrently), MATH 332

MATH 400 (Real Analysis): MATH 251

MATH 410* (Number Theory): MATH 230

MATH 430* (Applied Algebra): MATH 230, MATH 332 (may be taken concurrently)

MATH 431* (Computational Algebraic Geometry): MATH 230, MATH 332

MATH 454* (Graph Theory and Applications): MATH 230, (MATH 251 or 252)

MATH 475 (Probability): MATH 251

*Only one of MATH 410, 430, 431 and 454 is required.

AM **electives** have the following pre-requisites:

MATH 402 (Complex Analysis): MATH 251

MATH 420 (Geometry): instructor's consent

MATH 435 (Linear Optimization): MATH 230 or MATH 332

MATH 453 (Combinatorics): MATH 230

MATH 461 (Fourier Series and Boundary-Value Problems): MATH 251, 252

MATH 476 (Statistics): MATH 475

MATH 477 (Numerical Linear Algebra): MATH 350 or MMAE 350

MATH 478 (Numerical Methods for Differential Equations): MATH 350 or MMAE 350

MATH 481 (Introduction to Stochastic Processes): MATH 332 or 333, MATH 475

MATH 483 (Design and Analysis of Experiments): MATH 476

MATH 484 (Regression and Forecasting): MATH 476

MATH 485 (Introduction to Mathematical Finance): MATH 475

MATH 486 (Mathematical Modeling I): MATH 251, 252, 332, and 475

MATH 488 (Ordinary Differential Eqns & Dynamical Systems): MATH 251, 252

MATH 489 (Partial Differential Equations): MATH 461

Sometimes students wonder how our upper-level courses fit into the four main focus areas of the department (notice that some courses fit into several categories). In addition to the optional specializations discussed in Section VI, the following list provides a rough guide:

Focus area	Required courses	Elective courses
Applied Analysis	MATH 380	MATH 402
	MATH 400	MATH 461
		MATH 478
		MATH 486
		MATH 488
		MATH 489
Computational Mathematics	MATH 350	MATH 431
	MATH 380	MATH 435
		MATH 477
		MATH 478
		MATH 488
Discrete Mathematics	MATH 332	MATH 410*
	MATH 380	MATH 430*
	MATH 410, 430, 431, or 454	MATH 431*
		MATH 435
		MATH 453
		MATH 454*
Stochastics	MATH 380	MATH 453
	MATH 475	MATH 476

		MATH 481
		MATH 483
		MATH 484
		MATH 485
		MATH 486

*if not used as required course

9.2 Frequency of Course Offering

Students may expect courses to be offered according to the following algorithm:

Required courses:

- MATH 151, 152, 251, and 252 are offered **every semester** (all courses are also usually offered in the summer)
- MATH 100, 332, 400, and 475 are offered **every fall semester**
- MATH 230, 350, and 380 are offered **every spring semester**
- MATH 430 and 431 are offered **every other fall semester**
- MATH 410 and 454 are offered **every other spring semester**
- Many students view MATH 400 as a “hard” course and wait until their last year to take it.
- MATH 230 is equivalent to CS 330 and MATH 350 is equivalent to MMAE 350. Students may choose to take either version of these courses. However, CS 330 and MMAE 350 do not serve as (C) courses. Enrollment in the MATH sections is encouraged.

Elective courses:

The following **Four-Year Course Plan** is intended to provide a **tentative** schedule of future courses and thus help AM majors plan their curriculum. It covers a four-year interval through spring of 2019 and is meant to repeat with a four-year period after that, i.e., the fall of 2019 is projected to be identical with the fall of 2015.

Changes are possible subject to staffing and enrollment constraints and students wishing to request that a specific elective be offered at a time that deviates from this template should contact the associate chair *at least* one semester in advance. The most recent version can be found on the applied mathematics department website (<http://science.iit.edu/applied-mathematics/programs/course-descriptions/four-year-course-plan>).

	2015 F	2016 S	2016 F	2017 S	2017 F	2018 S	2018 F	2019 S
MATH 100	X		X		X		X	
MATH 151	X	X	X	X	X	X	X	X
MATH 152	X	X	X	X	X	X	X	X
MATH 230		X		X		X		X
MATH 251	X	X	X	X	X	X	X	X
MATH 252	X	X	X	X	X	X	X	X
MATH 332	X		X		X		X	
MATH 350		X		X		X		X
MATH 380		X		X		X		X
MATH 400	X		X		X		X	
MATH 402		X		X				X
MATH 410				X				X
MATH 420	X				X			

MATH 430	X				X			
MATH 431			X				X	
MATH 435		X				X		
MATH 453	X				X			
MATH 454		X				X		
MATH 461	X				X			
MATH 475	X		X		X		X	
MATH 476		X		X		X		X
MATH 477	X		X		X		X	
MATH 478		X		X		X		X
MATH 481			X				X	
MATH 483					X			
MATH 484	X		X		X		X	
MATH 485	X				X			
MATH 486	X		X		X		X	
MATH 488				X				X
MATH 489		X				X		

9.3 Forms, Petitions and Responsible Parties

FORM	AVAILABLE FROM	APPROVAL/ SUBMISSION
Registration	Use your Academics tab in http://my.iit.edu .	Advisor (Assoc. Dean if >18 hours and not ROTC)
Add and Drop/Withdrawal	Use your Academics tab in http://my.iit.edu . Paper forms also available at the Registrar's Office.	Advisor, department offering course if late registration
Course Repeat	Enter a petition in DegreeWorks at time of registration for course. Use your Academics tab in http://my.iit.edu .	Advisor (if received passing grade in original course).
Course Audit	Submit a request to the Office of the Registrar (registrar@iit.edu).	
Change of Grade	submitted online by course instructor	Course instructor
Academic Program Audit	Petition in DegreeWorks, or Undergraduate Academic Affairs (form at http://www.iit.edu/ugaa/services/academic_program_audit.shtml)	Undergraduate Academic Affairs after completing 60 credit hours
Declaration of Minor	Petition in DegreeWorks, or Undergraduate Academic Affairs (form at http://www.iit.edu/ugaa/services/academic_program_audit.shtml)	Consult with Advisor, but no formal approval required
Declaration of optional Specialization(s)	Petition in DegreeWorks, or Undergraduate Academic Affairs (form at http://www.iit.edu/ugaa/services/academic_program_audit.shtml)	Consult with Advisor, but no formal approval required
Application for Graduation	Undergraduate Academic Affairs (more info at http://web.iit.edu/ugaa/graduation-requirements)	Undergraduate Academic Affairs (submit by 4th week of semester)

Change of Major or Double Major	Undergraduate Academic Affairs (form at http://www.iit.edu/ugaa/services/change_declare_major.shtml)	Dept. Chair, submit to Undergraduate Academic Affairs
Petition for summer course transfer credit	Undergraduate Academic Affairs (form at http://www.iit.edu/ugaa/services/student_petitions.shtml)	Undergraduate Academic Affairs (before the course begins)
Credit by Proficiency Examination	Form may be obtained in the Office of the Registrar and a per-credit-hour fee is charged for each examination.	Instructor, Assoc. Dean, Dept. Chair of course requested
Application for Reinstatement	Undergraduate Academic Affairs (http://www.iit.edu/ugaa/services/reinstatement.shtml)	Undergraduate Academic Affairs
Co-op schedule	Career Management Center (http://www.cmc.iit.edu/)	Co-op advisor/Company
Leave of Absence or Withdrawal from the University	Undergraduate Academic Affairs (information at http://www.iit.edu/ugaa/services/withdrawal_leave_absence.shtml)	Undergraduate Academic Affairs

Appendix: B.S. in Applied Mathematics Requirements Worksheet

Student _____ ID _____ Full/Part-time

Applied Mathematics

Course	Hrs.	Semester
MATH 100 (C)	3	
MATH 151 (C)	5	
MATH 152 (C)	5	
MATH 230 (C)	3	
MATH 251	4	
MATH 252	4	
MATH 332	3	
MATH 350 (C)	3	
MATH 380 (C)	3	
MATH 400	3	
MATH 410/430/431/454 (C)	3	
MATH 475	3	
MATH	3	
MATH	3	
MATH	3	
MATH	3	
MATH	3	
MATH	3	
Total hours (60 hours minimum)		

This includes 18 hours of required electives.

Humanities

Course	Hrs.	Semester
HUM 200-level (C)	3	
(C)	3	
(C)	3	
Total hours (9 hours minimum)		

At least 6 hours at 300-level.

Social Sciences

Course	Hrs.	Semester
(C)	3	
(C)	3	
(C)	3	
Total hours (9 hours minimum)		

At least 6 hours at 300-level (3 hours if entered IIT before fall 2015). At least 6 hours in one field and at least two different fields.

Note: A total of **21 hours** are required for **humanities and social sciences combined**.

Minor

Course	Hrs.	Semester
	3	
	3	
	3	
	3	
	3	
Total hours (15 hours minimum)		

5 related courses from departments other than applied mathematics.

IPRO

Course	Hrs.	Semester
IPRO 397 (C)	3	
IPRO 497 (C)	3	
Total hours (6 hours minimum)		

Computer Science

Course	Hrs.	Semester
CS 115	2	
CS 104 or CS 116	2	
Total hours (4 hours minimum)		

Natural Science/Engineering

Course	Hrs.	Semester
PHYS 123	4	
	3	
	3	
	3	
Total hours (13 hours minimum)		

At least two courses in one field and at least two different fields.

Free Electives

Course	Hrs.	Semester
	3	
	3	
	3	
Total hours (9 hours minimum)		

Communications Core Requirement:

Minimum 36 hours of **C** courses, at least 12 in major courses and at least 12 in non-major courses. Place a **C** next to the courses used for the Communications requirement.

Notes on the B.S. in Applied Mathematics

General note: Courses marked in the IIT Bulletin as not applying to graduation for degrees in "engineering and the physical sciences" may not be used toward the B.S. in Applied Mathematics – this includes their use as free electives.

Applied mathematics electives: Any applied mathematics course at the 300-level or higher (including graduate MATH courses) except MATH 333, 374, 425, 426, 474 and 525 may be used as an applied mathematics elective. Courses from other programs may not be used as applied mathematics electives.

Minor: A minor may be chosen from the approved minors listed in the IIT Bulletin or may be formed from 15 hours of course work in one department. The latter option requires written approval from both the student's faculty advisor and the minor department.

Humanities electives: (AAH, *some* COM, HIST, LIT, PHIL) Humanities course work (courses marked with an **(H)** in the IIT Bulletin) must include at least 6 hours at the 300-level or above. Note that foreign language courses at the 200-level may be used to satisfy the 300-level requirement. This substitution requires written approval from the student's faculty advisor. All humanities courses carry the **(C)** for communications.

Social sciences electives: (ECON (but not BUS), LCHS, PS, PSYC, SOC, SSCI) Social sciences course work (courses marked with an **(S)** in the IIT Bulletin) must include at least 6 hours at the 300-level or above (only 3 hours of upper-level coursework are required for students entering before fall 2015). At least 6 hours of social sciences course work must be taken in one field (SSCI courses may be combined with PS or SOC to form a "field") and at least 3 hours in another field. Most PS, SOC and SSCI courses numbered above 300 require as prerequisite successful completion of at least one 200-level HUM course. Most **(S)** courses also carry the **(C)**.

Natural Science/Engineering electives: Science electives may be chosen from engineering, the natural sciences (BIOL, CHEM (both ok without lab), and PHYS), or PSYC (limited to courses marked with an **(N)** in the IIT Bulletin). At least one course must be in a field other than physics. At least two sequential courses in a single field (CHEM 124 followed by MS 201 also qualifies).

IPROs: One of the two required Inter-Professional Projects may be replaced for ROTC students (replaced with ROTC junior and senior required courses). Both of the two required Inter-Professional Projects might be replaced for full-time working students who can document interdisciplinary project work (replaced with applied mathematics elective and free elective). Co-Op cannot be used. A petition must be filed through the Office of Undergraduate Academic Affairs.

Free electives: The B.S. in applied mathematics allows for 9 hours of free electives.

ROTC programs: ROTC programs are considered to be minors and satisfy the requirements for minors listed above.

Graduate and short courses: Undergraduates may enroll in a 500-level graduate course with permission from the student's faculty advisor. Undergraduates may be eligible for enrollment in a co-terminal B.S./M.S. program. Undergraduates cannot enroll in short courses.

Communications Core Curriculum Requirement: Minimum 36 hours of **(C)** courses as marked in the IIT Bulletin of Undergraduate Programs, at least 12 hours in major courses (automatically satisfied by MATH 100, MATH 151, MATH 152) and at least 12 hours in non-major courses. Almost all Humanities and Social Science electives will count towards the communications requirement.

Academic Audits: All students should request an academic audit in their junior year (after completing 60 credit hours) from Undergraduate Academic Affairs. Minors (as well as optional Specialization) should be noted on the Academic Program Audit Request form. Audits can be compared to DegreeWorks or degree requirements worksheet to confirm accuracy.