UNDERGRADUATE MATHEMATICS HANDBOOK

DEPARTMENT OF MATHEMATICS
STONYBROOK UNIVERSITY

October 2005

This Handbook is intended for all students interested in the undergraduate mathematics program at SUNY Stony Brook, whether or not enrolled at present in the University.

The official source for rules and regulations of the University is the 2005 — 2007 Undergraduate Bulletin and its supplements. This Handbook in some cases amplifies information in those publications and in other cases summarizes it. All course names are listed in Appendix A of this Handbook; full course descriptions appear in the Undergraduate Bulletin and its supplements.

Contents

1 INTRODUCTION

Mathematics is an essential element in a wide range of human activities. It is the language of all the sciences, and as such is an indispensable tool in the formulation of the laws of nature. Its role in the physical sciences has been traditional for more than two centuries. In the social and biological sciences it plays an increasingly important role in modeling complicated, large-scale phenomena. It is an essential tool for computer science as well as all technology. In addition, mathematics has an aesthetic side; awareness of the possibility of elegance and beauty in mathematical arguments has been a significant feature of human culture throughout history. Today more mathematics is being done, and more needs to be done, than ever before. The mathematics needed for 21^{st} century science has not yet been discovered.

The faculty of the Department of Mathematics enjoys an outstanding international reputation. The Department offers courses at many levels, meeting the diverse needs of Stony Brook students. Courses range from those at the freshman level, which are offered in several sequences running at different paces, to advanced courses that prepare students for graduate studies in mathematics as well as being very useful for those intending to pursue their studies in mathematics intensive fields such as applied mathematics, statistics, physics, computer science and economics.

2 ADMINISTRATION OF THE UNDERGRADUATE MATHEMATICS PROGRAM

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Advising

The Undergraduate Math Office (Math P-143) is staffed by faculty advisors on a regular basis during the semester. Hours are posted outside the office and on the Web at

The Mathematics Learning Center (Math S-240A) is also open everyday, and has a schedule posted on the Web at
www.math.sunysb.edu/MLC/hours.shtml.

3 THE MATHEMATICS PROGRAM

3.1 Basic Mathematics Sequences

Stony Brook mathematics and mathematics-related courses use 3 letter designator MAT, MAE, MAP, CSE and AMS as follows:

MAT Mathematics

MAE Mathematics Education

MAP Mathematics Proficiency

CSE Computer Science

AMS Applied Mathematics and Statistics.

The Mathematics Department administers all of the MAT, MAP and MAE courses.

All MAT courses numbered 118 or higher, as well as all AMS and MAE courses, are applicable to the bachelor's degree requirements and they all satisfy DEC C category. MAT 118 is intended for students interested in developing their skills in quantitative reasoning and in problem solving, but who do not wish to take calculus. MAT 122 is a one-semester survey of differential and integral calculus that satisfies the mathematics requirement of the economics and psychology (B.A.) majors. MAT 123 gives an in depth preparation for the further study of calculus and is roughly equivalent to 12^{th}-grade material.

Students who have mastered 12^{th}-grade mathematics should start one of the calculus sequences. The three-semester sequence of one-variable calculus, MAT 125, 126, 127, is academically equivalent to the two-semester sequence MAT 131, 132. Engineering students normally take the faster paced MAT 131, 132 rather than MAT 125, 126, 127 because of the many requirements they must meet. MAT 141, 142 is the honors version of MAT 131,132. AMS 151 and 152 is a fast paced course that emphasizes applications.

For students whose high school preparation is insufficient, there are two review courses numbered MAP 101 and 103. MAP 103 is a skills course for students who need further work in high school algebra and related topics before continuing with other mathematics. Students who plan to take both calculus and statistics should take MAP 103, then calculus, and then calculus-based statistics.

There are two subjects studied at the 200 level, linear algebra (MAT 211) and multivariable calculus (MAT 203/205). A student who plans to take both classes should start with linear algebra, which may be taken in the same semester that the student is completing 100-level calculus. The calculus sequence is completed by a course on differential equations (MAT 303/305).

There are two courses in problem solving. MAT 160 is a one credit course called Mathematical Problems and Games, while the 1 credit MAT 260 aims to give students their first taste of what research in mathematics is like.

There is also a writing intensive course, MAT 200, concerned with logic and proof. This course,

or exemption from the course, is required for all mathematics majors. For students who are not in the Secondary Teacher Preparation Option, exemption can be obtained by taking a challenge examination at the beginning of each semester. !

3.2 Placement

Every entering freshman and transfer student takes the Mathematics Placement Examination online. The outcome of the test is one of nine levels of course recommendations:

Level 1 MAP 101

Level 2 MAP 103

Level 2+ MAT 118 or MAT 122 or AMS 101 or AMS 102

Level 3 MAT 123

Level 4 MAP 125

Level 5 MAT 131 or 141 or AMS 151

Level 6 MAT 126

Level 7 MAT 132 or 142 or AMS 161

Level 8 MAT 127 or 132 or 142 or AMS 161

Level 9 Beyond 100-level calculus

Detailed information about the placement examination may be found in the publication Mathematics Placement and Mathematics Courses, available from the office of New Student Programs and from the Mathematics Department.

3.3 The Mathematics Major

The undergraduate course offerings in mathematics allow students to set up individualized programs of study consistent with their academic interests and career plans. Students should consider majoring in mathematics even if they do not plan to become mathematicians or teachers of mathematics. The training in abstract reasoning and problem solving is an excellent foundation for many different careers, such as law, medicine, and business. Completion of a major in mathematics is regarded by employers as indicating that the student can apply reasoning and logic to the solution of business and industrial problems.

Students are encouraged to explore the various branches of pure and applied mathematics, as well as other mathematically oriented disciplines, in order to gain both breadth of knowledge and insight into career options. Mathematics majors are strongly encouraged to complete their DEC category E by the end of their sophomore year, so that they will have some experience of the interaction between mathematics and physical sciences. Mathematics majors can use their training as the foundation for advanced professional study, leading to research and teaching in

universities or research in industrial research laboratories; they can use it also in secondary school teaching. In industry, undergraduate training in mathematics is excellent preparation for the important task of liaison work between the technological arm of a company and its marketing arm. A major in mathematics is particularly appropriate for work in computer applications, operations research, and actuarial science. Double majors in mathematics and another field, such as physics, computer science, or economics, are common and are encouraged. The major in mathematics leads to a Bachelor of Science degree.

The **secondary teacher preparation option** is designed for students planning a career teaching mathematics in a secondary school. This option is described in detail in the section "Mathematics Secondary Teacher Preparation Program" of the current Undergraduate Bulletin.

The **honors program** is designed for students with a high standard of achievement who wish to study mathematics at an advanced level. This option is described in detail below. Any student interested in graduate studies in mathematics, or in mathematics-intensive sciences such as theoretical physics, should consider participating in the honors program.

Detailed information about major requirements and advice for majors may be found in the current Undergraduate Bulletin. The Mathematics Department encourages students to seek information and advice routinely on appropriate mathematics courses, programs, and career goals. Professors in mathematics are available as advisers in the Undergraduate Mathematics Office to help with these matters. Advising hours can be obtained by calling the Department of Mathematics, consulting the department's web pages or the bulletin board outside the Undergraduate Office.

Checklists of the requirements for the major appear in Appendix 8. Detailed information about the computer-literacy requirement appears in Appendix 5. Another requirement refers to a list of approved mathematics or mathematics-related courses; this list appears in this Handbook as Appendix 7. Students who entered the University in September 1986 or later and who were first-semester juniors in September 1988 or later, or who entered the University September 1988 or later, must meet an Upper-Division Writing Requirement as part of the major. The writing requirement for the mathematics major is explained in detail in Appendix F.

3.4 Secondary Teacher Preparation Option

This option is described fully in the current Undergraduate Bulletin. It is a program that prepares students for a career in the teaching of mathematics in the secondary schools. It leads to a Bachelor of Science degree in either mathematics or applied mathematics and to New York State provisional certification for teaching mathematics, grades 7-12.

Students wishing to enroll in the program should register with the Director of Mathematics Teacher Preparation by the end of the freshman year, if possible, and at the latest before registering for the junior year.

3.5 Honors Program

The honors program is designed for students with a high standard of achievement who wish to study mathematics at an advanced level. Any student interested in graduate studies in mathematics, or in mathematics-intensive sciences, such as theoretical physics, should consider participating in this program.

The honors program is open to junior and senior mathematics majors who have completed at least two upper-division MAT courses with grades of B or higher and who have maintained a 3.0 overall grade point average. A prospective honors major must declare to the director of undergraduate studies an intention to participate in the program sometime before registering for the senior year.

The program consists of a set of six MAT courses–at least three of which are not used to fulfill the MAT major requirements. These courses should include: MAT 322, MAT 401 and/or MAT 402, a course in algebra other than MAT 310 or MAT 318; and MAT 495. Substitution of appropriate graduate courses is permitted, and other substitutions are possible at the discretion of the undergraduate director. In particular, students who write a suitable thesis on a topic in mathematics may submit this as partial fulfillment of the Honors program requirements even though they have not formally registered for MAT 495. Conferral of honors is contingent upon:

- Completion of the set of six courses with a grade point average of at least 3.5.
- Approval for honors by the faculty member (or members) who supervises MAT 495 or its equivalent.

3.6 Minor in Mathematics

Although Stony Brook students are not required to pursue a minor to graduate, some choose to pursue a minor in mathematics. A checklist for the requirements for this minor appears in this Handbook as Appendix J; details may be found in the current Undergraduate Bulletin.

3.7 How to Declare a Major or Minor in Mathematics

Come to the Undergraduate Mathematics Office in Mathematics P-143 during hours when the Director or other faculty advisor is available. It will be necessary to fill out two forms—a departmental information form and a "Change of Major/Minor/Area of Interest Form", both of which are available in the mathematics office. The Director or advisor will sign the latter form and will provide further information about the major/minor and about the advising process.

3.8 The Mathematics Club

This is a student run club open to everyone. It meets once a week on Thursdays at 7PM. More information can be found on its web page at www.sbmath.org.

3.9 The Undergraduate Bulletin Board

This is in the Plaza Level of the Mathematics building, opposite the elevators. All notices relevant to the Undergraduate Program are posted there.

4 FACILITIES

4.1 Mathematics-Physics Library

The Math–Physics Library is located in C-124 in the Physics Building adjacent to Mathematics. It has open stacks and is the usual place where books are put on reserve for mathematics courses. The library has more than 38,000 books, of which about 60% concern mathematics, and 27,000 bound journals, of which about 40% concern mathematics. The library subscribes to 500 journals, of which about 200 are in mathematics and 150 others are in applied mathematics.

4.2 MATHLAB AND SINC Site for Instructional Computing

The instructional computing site is located in S-235 of the Mathematics Building. This room has a number of computers with Windows XP and RedHat Linux operating systems. Available software includes mathematical packages such as *Maple*, *Matematica*, and *Matlab*. It is open about 40 hrs a week, and is used by several departments for teaching purposes, as well as by students for research and course work. Anyone registered in an MAT or AMS class is eligible to open an account in the Mathlab (instructions to do this are posted in the Lab itself). Mathematics majors are strongly encouraged to open such an account, since it gives the Mathematics department an easy way to keep in touch.

4.3 Mathematics Learning Center

The Mathematics Learning Center and Calculus Resource Room are located in room S-240A in the basement of the Math building. All instructors of MAP and MAT 100 undergraduate courses hold at least some of their office hours there and there are other tutors as well to help students who have difficulties with calculus or pre-calculus courses. You do not need an appointment, but will be served on a first-come first-served basis. The schedule for the tutoring center, and the schedules for individual instructors are posted in the center, and can be found on the web.

5 SUPPORT SERVICES

5.1 Assistance within a Course

Help with course work should first be sought from the instructor and/or TA in the course. Office hours for faculty and graduate students are posted at the door of the Undergraduate

Mathematics Office, Mathematics P-143, and in the entry way of the office.

Free individual tutoring is available for all MAP and MAT 100 level courses in the Mathematics Learning Center and Calculus Resource Room (Physics A-127). The Mathematics Department also maintains a list of paid tutors; inquiries should be directed to the Undergraduate Mathematics Office in Mathematics P-143 (telephone 632-8250).

Another source of available help is the Writing Center in Humanities 198. The brochure Help! describes this and other support services and is available in the Center for Academic Advising (Library 2360). Advisers there are also an important source of assistance for students in academic difficulty.

5.2 Advising about Academic or Personal Matters

For advice about interdepartmental academic matters, the place to start is the Center for Academic Advising (Library 2360). For advice about mathematics placement in the freshman-sophomore courses, the people to see are Professor Geller (Associate Director of Undergraduate Studies in charge of Placement) or one of the faculty advisers in the Undergraduate Mathematics Office P-143. For advice about the major program in mathematics or about career opportunities or graduate school, the appropriate people are the Director of Undergraduate Studies in Mathematics, one of the faculty advisers in P-143, or, if you already are a mathematics major, your assigned faculty adviser.

The University Counseling Center (2nd Floor, Infirmary, 632-6720) provides crisis intervention and individual and group counseling for full-time students. The Center also provides programs for personal growth and enrichment for students, faculty, and staff. All Center services are free of charge. All information about a student's counseling is confidential except in situations where there is a threat or danger to life. A brochure available in Mathematics P-143 explains the services available from the Center and lists some kinds of problems that students bring to the Center.

Students with a physical, psychiatric, medical, or learning disability that may impact on their ability to carry out assigned course work are urged to contact the staff in the Disabled Student Services office (DSS), 128 ECC building, 632-6748. DSS will work with the student to determine what accommodations are necessary and appropriate. All information and documentation of disability is confidential.

5.3 Concerns and Complaints

Students with concerns about the mathematics program that are not related to a specific course should speak with the Director of Undergraduate Studies in Mathematics. If a specific course is involved, the best way to resolve a complaint is with the instructor of the course. When such an approach seems blocked or fruitless, the student should talk to the Director. If the student is still not satisfied, the next step is to speak with the Department Chair or Associate Chair.

Questions about semester grades in courses should be addressed to the instructor. In any event

an instructor can only recommend a grade change, not implement it. Such a recommendation will generally be accepted only when a clerical error was involved, not when a change of judgment occurred.

6 TRANSFER COURSE EVALUATION

Courses transferred from another institution may be evaluated for equivalency with Stony Brook MAT courses numbered 200 or higher. For courses transferred from the nearby colleges (Suffolk, Nassau, and Farmingdale), this evaluation takes place automatically and is done in accordance with booklets of equivalencies published annually by the Undergraduate Transfer Office. Mathematics courses from other universities and colleges must be evaluated by a faculty adviser in the Udergraduate Mathematics Office. Evaluation is based on information available from that school, principally the catalog course description. When the catalog course description is insufficient, a syllabus and the name of the textbook may be needed. Forms for evaluating transfer courses for equivalency with Stony Brook courses are available at the Undergraduate Mathematics Office (P-143), at the Center for Academic Advising, and at the Office of Admissions.

Students who plan to take a mathematics course at another institution in order to earn an MAT equivalency at Stony Brook should have that course assessed before it is taken. This assessment will amount to advice in the case of 100-level MAT courses and to a commitment in the case of higher level MAT courses. Mathematics courses taken elsewhere are not normally given final upper-division MAT Stony Brook equivalency until validated by passing a subsequent course at Stony Brook. The appropriate form for obtaining an evaluation is "Request and Authorization to Take Courses at Another Institution" and is available from the Undergraduate Mathematics Office (P-143) and from the Undergraduate Transfer Office.

7 OPPORTUNITIES FOR GRADUATE SCHOOL

Many careers in which mathematics is used require study beyond the bachelor's degree level. Many universities offer graduate degree programs in mathematics. These usually lead to a master's degree (Master of Arts or Master of Science) and often to the degree of Doctor of Philosophy (Ph.D.). Some universities offer special graduate programs for teachers leading to degrees of Master of Arts, Master of Arts in Teaching, Doctor of Arts, or Doctor of Education.

Qualifications for admission to graduate school vary greatly, depending on the particular school and the particular program. High grades in mathematics courses and good letters of recommendation from known recommenders are the most important factors. Some universities require applicants to take the Graduate Record Examination.

Information about graduate schools in mathematics is available from many sources. Each year in the fall, the American Mathematical Society publishes a special issue of its *Notices* listing all graduate-degree granting institutions, along with data on numbers of degrees granted, fellowships and assistantships, etc. Another source of information is the book "Peterson's Graduate Programs in the Physical Sciences and Mathematics", available for borrowing in the Undergrad-

uate Mathematics Office. Individual faculty members in the Mathematics Department, including the Director of Undergraduate Studies, are an excellent source of information about graduate schools.

Full-time graduate students in mathematics programs leading to the Ph.D. degree seldom pay for their graduate education. Most such students have fellowships or assistantships, with waivers of tuition. The example of Stony Brook will give an idea of the nature of a teaching assistantship: the duties typically consist of teaching one undergraduate course or two recitation sections each semester, and the stipend is at least $11,400 for the academic year, plus tuition, and possible summer support.

The bulletin boards outside the Mathematics Undergraduate Office contain advertisements for graduate schools in mathematics and related fields, as well as announcements of opportunities for fellowships.

8 CAREER OPPORTUNITIES IN MATHEMATICS

The Undergraduate Mathematics Office has copies of career pamphlets available for use in the office. These include several pamphlets about single fields. Two are more general.

The first is "Professional Opportunities in the Mathematical Sciences", published by the Mathematical Association of America. This pamphlet gives an indication of the variety of careers available to people with interest and training in the mathematical sciences. The classes of professions discussed are grouped as follows:

- Classical Applied Mathematics and Engineering
- Computer Science
- Operations Research
- Statistics
- The Actuarial Profession
- Interdisciplinary Areas
- Teaching
- Government, Business, and Industry

A final chapter discusses mathematics as a background for other professions. There is a lengthy bibliography.

The second is "Careers for Women in Mathematics", published by the Association for Women in Mathematics. This pamphlet summarizes the kinds of careers that are available for men and women, discusses issues of discrimination, and has its own useful bibliography.

The "Combined Membership List of the American Mathematical Society, the Mathematical Association of America, and the Society for Industrial and Applied Mathematics" has a short list of corporate members. Students who like to make inquiries by letter about employment by a corporation may wish to write to these corporate members. The Combined Membership List is available in the Mathematics-Physics Library.

Useful web addresses:

The American Mathematical Society:	www.ams.org
Association for Women in Mathematics:	www.awm.math.org
Mathematical Association of America:	www.maa.org

APPENDIX A UNDERGRADUATE COURSES

Here is a list of all of the undergraduate courses to be offered by the Department of Mathematics. Consult the current Undergraduate Bulletin and its supplements for course descriptions, semesters offered, credits, etc.

MAP 101 - Fundamentals of Arithmetic and Algebra

MAP 103 - Proficiency Algebra

MAT 118 - Mathematical Thinking

MAT 122 - Overview of Calculus

MAT 123 - Introduction to Calculus

MAT 125 - Calculus A

MAT 126 - Calculus B

MAT 127 - Calculus C

MAT 131 - Calculus I

MAT 132 - Calculus II

MAT 141 - Honors Calculus I

MAT 142 - Honors Calculus II

MAT 160 - Mathematical Problems and Games

MAT 200 - Language Logic Proof

MAT 203/303 - Calculus III, IV with applications

MAT 205/305 - Calculus III, IV

MAT 211 - Introduction to Linear Algebra

MAT 260 - Problem Solving in Mathematics

MAT 310 - Linear Algebra

MAT 311 - Number Theory

MAT 312 - Applied Algebra

MAT 313 - Abstract Algebra

MAT 316 - Invitation to Modern Mathematics

MAT 318 - Classical Algebra

MAT 320 - Introduction to Analysis

MAT 322 - Analysis in Several Dimensions

MAT 324 - Real Analysis

MAT 331 - Computer-Assisted Mathematical Problem Solving

MAT 341 - Applied Real Analysis

MAT 342 - Applied Complex Analysis

MAT 351 - Differential Equations: Dynamics and Chaos

MAT 360 - Geometric Structures

MAT 362 - Differential Geometry of Surfaces

MAT 364 - Topology and Geometry

MAT 371 - Logic

MAT 373 - Analysis of Algorithms

MAT 401, 402 - Seminars in Mathematics

MAT 475 - Undergraduate Teaching Practicum

MAT 487 - Independent Study in Special Topics

MAT 495 - Honors Thesis

MAE 301 - Foundations of Secondary School Mathematics

MAE 302 - Methods of Teaching Secondary School Mathematics

MAE 311 - Classroom Observations

MAE 312 - Micro-Teaching

MAE 330 - Technology in the Mathematics Classroom

MAE 447 - Directed Readings in Mathematics Education

MAE 451 - Student Teaching: Middle School

MAE 452 - Student Teaching: High School

MAE 454 - Student Teaching Seminar

APPENDIX B GRADUATE COURSES OPEN TO UNDERGRADUATES

With permission, a student may take any of the following graduate courses for credit while an undergraduate. The appropriate form for securing permission is available in the Undergraduate Mathematics Office. At most, two of these courses may be used to meet undergraduate degree requirements.

MAT 530 - Topology/Geometry I

MAT 531 - Topology/Geometry II

MAT 534 - Algebra I

MAT 535 - Algebra II

MAT 539 - Algebraic Topology

MAT 542 - Complex Analysis I

MAT 543 - Complex Analysis II

MAT 544 - Analysis

MAT 546 - Differential Equations

MAT 550 - Real Analysis I

MAT 551 - Real Analysis II

MAT 566 - Differential Topology

MAT 568, 569 - Differential Geometry

APPENDIX C AN OVERVIEW OF 300 LEVEL COURSES AT STONY BROOK

This appendix describes the 300 level courses that are offered by the Mathematics Department. The courses are grouped by subject, and within each subject are listed in roughly increasing level of difficulty. Students should be warned that the present numbering system is highly illogical, i.e. a higher number in no way indicates a more difficult class. Also the prerequisites have been changed since the 2000-2001 Undergraduate Bulletin was printed, and are correctly listed below. **!**

The most accessible classes are: MAT 318, 312, 303/305, and 360 and it is recommended that students start by taking some of these before trying other 300 level classes. The most advanced classes are MAT 313, 311, 322, 362 and 401/402. Students thinking about going to graduate school in mathematics should consider taking beginning graduate classes such as Topology/Geometry I (MAT 530) and Algebra I (MAT 534).

Students are strongly encouraged to consult with a faculty advisor before planning their schedule.

C.1 Algebra

MAT 312 (Applied Algebra) (Crosslisted with AMS 351) – studies number congruences, groups and codes. A mixture of theory and applications, with some computer projects on public key cryptography and error correcting codes. An accessible class. Prerequisite: MAT 211 or AMS 210 (Fall and Spring), MAT 200 advised.

MAT 310 (Linear Algebra) – develops the basic theory of linear algebra. It is one of the two courses (MAT 320 is the other) in which student are taught how to write proofs, and is required

for math majors. Prerequisite: MAT 211 or 305 or AMS 210 (Fall and Spring). Corequesite: MAT 200.

MAT 313 (Abstract Algebra) – develops the abstract theory of groups, rings and fields. Highly recommended for those planning to go to graduate school. Prerequisite: MAT 310 or 312 (Fall only) or MAT 200.

MAT 311 (Number theory) – this classical and beautiful subject has surprising applications. This class has newly increased prerequisites, and so will be able to go fairly deeply into this subject. Prerequisite: MAT 312 or 313 (Spring) or MAT 200.

C.2 Differential equations

MAT 303 and 305 (Calculus IV) – a basic introduction to differential equations; prerequisite for all subsequent courses in this area. Advisory Prerequisite: Calculus III

MAT 341 (Applied Real Analysis) – a study of the classical equations governing the flow of heat, the motion of waves, and the distribution of electric charge. Prerequisite: Calculus III and Calculus IV (Fall), MAT 200 advised.

MAT 351 (Differential equations: Dynamics and Chaos) – studies systems which evolve with time, sometimes in a chaotic manner. Involves short computer projects. Prerequisite: Calculus III and Calculus IV (Spring) or MAT 200.

Calculus I means MAT 125, or 131, or 141, or AMS 151

Calculus III means MAT 203, or 205, or AMS 261

Calculus IV means MAT 303, or 305, or AMS 3361

C.3 Analysis

MAT 342 (Applied complex analysis) – studies complex valued functions of a complex variable. These functions have many beautiful and unexpected properties, as well as many applications, for example in physics. Prerequisite: Calculus III and Calculus IV (Spring); MAT 200 advised.

MAT 319/320 (Introduction to Analysis) – an introductory course in analysis, required for math majors. It provides a closer and more rigorous look at material which most students encountered on an informal level during their first two semesters of Calculus. Students learn how to write proofs. Students (especially those thinking of going to graduate school) should take this as early as possible, typically in their junior year. Prerequisite: Calculus III or MAT 211 or A- or higher in MAT 132 or 142 or 127 or AMS 161or MAT 200.

MAT 322 (Analysis in several dimensions) – continues MAT 320, revisiting and developing the basic ideas of many-variable calculus. Since most applications of calculus involve working in more than one dimension, this is essential preparation for graduate level mathematics, and excellent background for graduate study in any science. Prerequisite: MAT 320 and Calculus

III (Spring)

MAT 324 (Real Analysis) – continues MAT 320, begins with point-set topology, and discusses continuous functions on general metric spaces, greatly generalizing results on continuity from MAT 320. Then covers Lebesgue measure and the Lebesgue integral. These notions are fundamental for modern mathematics and indispensable for theoretical physics as well. Prerequisite: MAT 320 and Calculus III (Fall).

C.4 Topology and Geometry

MAT 360 (Geometric Structures) – develops and contrasts Euclidean geometry with more exotic geometries, emphasizing topics relevant to the high school curriculum. Involves some computer workshops using software available in high schools. An accessible class. Pre or co-requisites: Calculus III; MAT 211 or AMS 210 (Spring)

MAT 364 (Topology and Geometry) – a broadly based introduction to mathematical theories of space, shape and form. Topics are selected from intuitive knot theory, lattices and tilings, non-Euclidean geometry, smooth curves and surfaces in Euclidean 3-space, open sets and continuity, combinatorial and algebraic invariants of spaces, higher dimensional spaces. Though there are no formal 300 level prerequisites for this class, it is advisable for students to have taken some analysis or differential equations class first. Prerequisite: Calculus III (Fall)

MAT 362 (Differential Geometry of Surfaces) – studies the shapes of low-dimensional spaces and how they curve. Prerequisite: MAT 320 or MAT 364 (Spring)

C.5 Various

MAT 331 (Computer-Assisted Mathematical Problem Solving) - Use of the computer as a tool to gain insight into complex mathematical problems. The course is organized in a project-oriented approach: after initial familiarization with the basic computational tools, several different mathematical problems are examined. Students learn both the relevant mathematical concepts and ways that the computer can be used (and sometimes misused) to understand them. The particular problems may vary by semester; past topics have included cryptography, fractals and recursion, modeling the flight of a glider, curve fitting, the Brachistochrone, computer graphics, etc. No previous experience with computers is required. Prerequisite: MAT 203 or MAT 205 or AMS 261.

MAT 316 (Invitation to Modern Mathematics) – aims to give students an idea what research in mathematics is about. Students first study the proofs of some basic results to get a feel for the kinds of ideas and arguments which lead to interesting conclusions, and then start asking their own questions and trying to come up with some answers. The grade is based on homework and an extended project. The formal prerequisites for this class are few, and students at all stages have enjoyed taking it. The main qualification is an interest in mathematics. Prerequisite: Calculus III; MAT 211 or AMS 210 (Spring)

MAT 371 (Logic) (Crosslisted with CSE 371) – A survey of the logical foundations of

mathematics, including Godel's completeness theorem. Prerequisite or Co-requisite: MAT 200 or CSE 213. (Spring)

MAT 373 (Analysis of Algorithms) (Crosslisted with AMS 373 and CSE 373) – Mathematically analyses a variety of computer algorithms, and introduces the theory of NP completeness. Computers are used to implement and compare algorithms. Prerequisites: MAT 211 or AMS 210; CSE 214 (Fall and Spring)

MAT 401/2 (Seminar in Mathematics) – a bridge between undergraduate and graduate level mathematics, and may be repeated. Topics vary from semester to semester. The Fall 99 topic is Dynamical Systems and the Spring 2000 topic may be Measure Theory and Probability. Recent topics have included: Manifolds and Tensors, Differential Geometry, Distribution Theory, and Foundations of Mathematical Logic. Required for the Honors program and highly recommended for those thinking of graduate school. Prerequisite: MAT 320 (Fall and Spring)

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APPENDIX D PROFESSORS AND THEIR RESEARCH

The list below shows tenured and tenure-track professors in the Department as of October 2005. In addition to this, our faculty include a number of Simons instructors, lecturers, and visitors. You can find the most up-to-date list on the department web page at http://www.math.sunysb.edu/html/faculty-alph.shtml.

D.1 Distinguished Professors

James Glimm, Ph.D., 1959, Columbia University: Applied mathematics; numerical analysis, mathematical physics.

H. Blaine Lawson, Jr., Ph.D., 1968, Stanford University: Differential geometry, topology; algebraic geometry;

Dusa McDuff, Ph.D., 1971, Cambridge University, England: Geometry; Symplectic topology.

John W. Milnor, *Director of the Institute for Mathematical Sciences*, Ph.D., 1954, Princeton University: Dynamical systems.

Dennis Sullivan, Ph.D., 1965, Princeton University: Dynamical systems, geometry, partial differential equations.

D.2 Professors

Michael T. Anderson, Ph.D., 1981, University of California, Berkeley: Differential geometry.

William Barcus, D.Phil., 1955, University of Oxford, England: Algebraic topology.

Christopher Bishop, Ph.D., 1987, University of Chicago: Complex Analysis.

David Ebin, *Chairperson*, Ph.D., 1967, Massachusetts Institute of Technology. Global analysis; mathematics of continuum mechanics; partial differential equations.

Daryl Geller, Ph.D., 1977, Princeton University: Partial differential equations; harmonic analysis; several complex variables; Lie groups.

Detlef Gromoll, Ph.D., 1964, University of Bonn, Germany: Differential geometry.

C. Denson Hill, Ph.D., 1966, New York University: Partial differential equations; several complex variables.

Lowell Jones, Ph.D., 1970, Yale University: Topology; geometry.

Anthony Knapp, *Emeritus*, Ph.D., 1965, Princeton University: Lie groups; representation theory.

Irwin Kra, *Emeritus*, Ph.D., 1966, Columbia University: Complex analysis, Riemann surfaces, Kleinian groups, Teichmüller theory. Applications to mathematical physics and number theory.

Paul Kumpel, *Emeritus*, Ph.D., 1964, Brown University: Algebraic topology. Recipient of the State University Chancellor's Award for Excellence in Teaching, 1990, and the President's Award for Excellence in Teaching, 1990.

Claude LeBrun, D.Phil., 1980, University of Oxford, England: Differential geometry; algebraic geometry; complex analysis; mathematical physics.

Mikhail Lyubich, Ph.D., 1983, Tashkent State University, former Soviet Union: Dynamical systems.

Bernard Maskit, Ph.D., 1964, New York University: Complex analysis, Riemann surfaces; Kleinian groups and deformation spaces.

Marie-Louise Michelsohn, Ph.D., 1974, University of Chicago: Differential geometry.

Anthony Phillips, Ph.D., 1966, Princeton University: Differential topology and applications to mathematical physics.

Leon Takhtajan, Ph.D., 1975, Leningrad Branch of the Steklov Mathematical Institute, Russia: Mathematical physics.

D.3 Associate Professors

Mark de Cataldo, Ph.D., 1995, University of Notre Dame: Higher Dimensional Geometry.

Alexander Kirillov, Jr., Ph.D., 1995, Yale University: Representation theory, low dimensional topology, mathematical physics.

Sorin Popescu, Ph.D., 1993, University of Saarland, Germany: Algebraic geometry and computational algebraic geometry.

D.4 Assistant Professors

Neil Portnoy, Ph.D., 1998, University of New Hampshire: Secondary mathematics teacher education, undergraduate mathematics learning

Dror Varolin, Ph.D.: Several Complex Variables, Algebraic Geometry, Complex Geometry, Dynamical Systems

Aleksey Zinger, Ph.D., 2002, MIT: Symplectic Topology and Enumerative Algebraic Geometry

APPENDIX E COMPUTER-LITERACY MAJOR REQUIREMENT

Requirement #3 of the mathematics major is one course in computer literacy. This course may be any of the following:

MAT 331 is a course that tells how to get some information about a difficult mathematics problem by doing some numerical work on a computer. This course is suitable for students who expect to use mathematics in problem-solving professionally. No computer experience is necessary. At least one section of MAT 331 is now offered every semester; enrollment in each section is strictly limited to 23 students.

CSE 113 and 114 are suitable for students with a special interest in computer science and for those prospective secondary school teachers who have the time for two courses. CSE 110 has no prerequisites, and is another way to satisfy the requirement.

MEC 111 is open each semester to a limited number (six) of mathematics majors. The procedure for enrolling is as follows: During the preregistration period, ask in the Undergraduate Mathematics Office (Mathematics P-143) to have your name put on the list of math majors enrolling in the course. Preregister for the course, and do not be alarmed that your registration is blocked. Attend the first class, and fill out the questionnaire given at that time, answering that you are an MAT major and that you need the course for your major requirements. Students are admitted to the course by the Undergraduate Engineering Office, and that office will have a copy of the list assembled by the Mathematics Office.

Students graduating in the Secondary Mathematics Teaching Program may also satisfy the requirement by:

MAE 330 (Technology in the Mathematics Classroom) is a course intended for those in the teacher preparation program. It explores ways to use graphing calculators and computing software packages in the classroom.

APPENDIX F WRITING REQUIREMENT FOR MATHEMATICS MAJOR

Each major in the University has an Upper-Division Writing Requirement. The Department of Mathematics requirement is as follows:

> In order to satisfy the departmental writing requirement, each student majoring in Mathematics, including double majors, must submit an acceptable portfolio of three pieces of writing from upper-division MAT or MAE coursework. Students should aim for completion of the portfolio early in the next-to-last semester to allow time to resolve any difficulties. Each piece in it must have been approved by a Mathematics faculty member as being mathematically correct and well written.

The paper submitted may be of the following types:

1. A graded final exam for which the student wrote sufficiently many mathematical proofs.

   (Students should promptly ask to see suitable graded final exams–for example, those in MAT 310, 312, 313, 318, or 320. The course instructor will act as the faculty reviewer for the exam.) A faculty member may decide that the student can substitute a midterm exam or an extensive set of homeworks for the final exam in a particular course.

2. Class notes that have been taken by the student and recast.

3. A set of lesson plans such as those required in MAE 302.

4. A course paper or a suitable special project approved by the Undergraduate Director.

At least one piece must be of type 1. At most, one may be of type 3. At least two courses must be represented. Successful participation in MAT 491 Honors Seminar or MAT 495 Honors Thesis may count in lieu of one of the three items. At the discretion of the Director of Undergraduate Studies or a designee, one or two longer papers may be accepted in place of three short ones.

In all cases, each piece must be judged suitable for the writing requirement by a Mathematics faculty member before the piece is submitted. Typically the faculty member will be the instructor of the associated course. The faculty member may require that the exam paper or project be revised before it is approved. In this case a copy of the original work should be submitted along with a copy of the revised version. The faculty member indicates that a writing sample is suitable for the writing requirement by signing and dating a statement to that effect on the sample.

The completed portfolio is submitted to the Department of Mathematics Undergraduate Office. Accepted portfolios will be acknowledged and will be returned to the students.

APPENDIX G LIST OF MATHEMATICS-RELATED COURSES

These courses may be used to satisfy the mathematics major requirements as described with 2005/2007 Undergraduate Bulletin or #6 of Appendix H.

1. MAE 301
2. Any MAT course numbered 310 or higher except 475
3. Any AMS course numbered 301 or higher except 361 and 475
4. Any CSE course numbered 301 or higher except 475
5. CHE 301, 302, 351, 353
6. ECO 321, 320, 348
7. PHY 301, 302, 303, 306, 308, 403, 405, 408
8. PHI 330

9. ESE 310, 315, 319, 321, 337

Other courses (such as mathematics intensive topics courses in economics) that a student would like to use to satisfy these requirements must be proposed by the student and approved by the Director of Undergraduate Studies.

APPENDIX H CHECKLIST FOR MAJOR REQUIREMENTS (NOT FOR MAJORS IN SECONDARY EDUCATION OPTION)

NAME:_____ **ID#:**_____

1. MAT 125/126/127____ (Calculus A/B/C) or MAT 131/132____ (Calculus I/II) or MAT 141/142____ (Honors Calculus I/II) or AMS 151/161____ (Applied Calculus I/II)

2. MAT 203____ (Calculus III with Applications) or MAT 205____ (Calculus III) or AMS 261____ (Applied Calculus III)

3. MAT 211____ (Intro to Linear Algebra) or AMS 210____ (Applied Linear Algebra)

4. MAT 303____ (Calculus IV with Applications) or MAT 305____ (Calculus IV) or AMS 361____ (Applied Calculus IV)

5. MAT 200____ (Language Logic Proof) or Challenge Exam____

6. MAT 331____ (Comp & Math Prob solving) or CSE 110____ (Intro to Computer Science) or MEC 111____ (Computer Science for Engineers) or CSE 114____ (Computer Science II)
   (see Appendix E for more information)

7. MAT 310____ (Linear Algebra)

8. MAT 312/AMS 351____ (Applied Algebra) or MAT 313____ (Abstract Algebra)

9. MAT 319____ (Foundations of Analysis) or MAT 320____ (Introduction to Analysis)

10. MAT 341____ (Applied Real Analysis) or MAT 342____ (Applied Complex Analysis) or MAT 322____ (Analysis in Several Dimensions) or MAT 324____ (Measure Theory)

11. Four MAT courses numbered 310 or above, beyond those taken to satisfy 4, 5, 7, 8, 9, 10 (MAT 331 can be used) OR five acceptable math-related courses (see Appendix G on Page 23).

    _____ _____ _____
    _____ _____

12. Upper-Division Writing Requirement (see Appendix F on Page 22)
    Expository: ____ Expository: ____ Proof:____

Have all the above courses been taken for a letter grade and completed with grade of C or higher?____

APPENDIX I CHECKLIST FOR HONORS REQUIREMENTS

The honors program is designed for students with a high standard of achievement who wish to study mathematics at an advanced level. Any student interested in graduate studies in mathematics, or in mathematics-intensive sciences such as theoretical physics, should consider participating in this program.

The honors program is open to junior and senior mathematics majors who have completed at least two upper-division Mat courses with grades of B or higher and who have maintained a 3.0 overall grade point average. Prospective honors majors must declare to the director of undergraduate studies an intention to participate in the program, sometime before registering for the senior year.

The program consists of a set of six MAT courses, at least three of which are not used to fulfill the MAT major requirements. These courses should include: MAT 322, MAT 401 or MAT 402, a course in algebra other than MAT 310 or MAT 318; and MAT 495. Substitution of appropriate graduate courses is permitted, and other substitutions are possible at the discretion of the undergraduate director. In particular, students who write a suitable thesis on a topic in mathematics may submit this as partial fulfillment of the Honors program requirements even though they have not formally registered for MAT 495. Conferral of honors is contingent upon:

1. Completion of the set of six courses with a grade point average of at least 3.5.
2. Approval for honors by the faculty member or members who supervises MAT 495, (or its equivalent).

NAME: _____ **DATE** _____

	Permissible Substitutions	Planned Semester for the class	Completed Grade
MAT 322			
MAT 401			
MAT 402			
MAT 495			

Indicate by * courses not used to fulfill MAT major requirements.

Other Major:_____

Expected graduation date:_____

APPENDIX J CHECKLIST FOR MINOR REQUIREMENTS

The minor requires 21 to 23 credits.

NAME:_____

0. MAT 125/126/127____ (Calculus A/B/C) or MAT 131/132____ (Calculus I/II) or MAT 141/142____ (Honors Calculus I/II) or AMS 151/161____ (Applied Calculus I/II)

1. MAT 211____ (Intro to Linear Algebra) or AMS 210____ (Applied Linear Algebra)

2. MAT 203____ (Calculus III with Applications) or MAT 205____ (Calculus III) or AMS 261____ (Applied Calculus III)

3. MAT 310____ (Linear Algebra) or MAT 312____ (Applied Algebra) or MAT 313____ (Abstract Algebra)

4. MAT 320____ (Intro to Analysis) or MAT 341____ (Applied Real Analysis) or MAT 342____ (Applied Complex Analysis)

5. Three Additional MAT courses numbered MAT 303 or above (excluding MAT 475)

_____ _____ _____

Have all the above courses been taken for a letter grade and completed with grade of C or higher?____

APPENDIX K CHECKLIST FOR SECONDARY TEACHER PREPARATION PROGRAM

NAME:_____ **ID#:**_____

1. MAT 125/126/127____ (Calculus A/B/C) or MAT 131/132____ (Calculus I/II) or MAT 141/142____ (Honors Calculus I/II) or AMS 151/161____ (Applied Calculus I/II)
2. MAT 203____ (Calculus III with Applications) or MAT 205____ (Calculus III) or AMS 261____ (Applied Calculus III)
3. MAT 211____ (Intro to Linear Algebra) or AMS 210____ (Applied Linear Algebra)
4. MAT 200____ (Language Logic Proof) or Challenge Exam____
5. MAT 303____ (Calculus IV with Applications) or MAT 305____ (Calculus IV) or AMS 361____ (Applied Calculus IV)
6. MAE 330____ (Technology in the Math Classroom) or MAT 331____ (Computers & Math Problem Solving) or CSE 114____ (Foundations of Computer Science II)
   (see Appendix E for more information)
7. MAT 310 (Linear Algebra) _____
8. MAT 312____ (Applied Algebra) or MAT 313____ (Abstract Algebra)
9. MAT 319____ (Foundations of Analysis) or MAT 320____ (Introduction to Analysis)
10. AMS 310 (Survey of Probability and Statistics)___
11. MAT 360____ (Geometric Structures) or MAT 364____ (Topology and Geometry)
12. MAT 336 (History of Math) ____Fulfills DEC H requirements

NOTE: MAE 330, MAT 312, MAT 319, and MAT 360 are specially designed for prospective teachers and are highly recommended.

13. MAE 301 (Foundations of Secondary School Math) _____ MAE 311 (Intro to Methods of Teaching) _____
    MAE 302 (Methods and Materials for Teaching) _____ MAE 312 (Micro-Teaching) _____
    MAE 447 (Directed Readings in Math) _____ MAE 451_____MAE 452_____
    Supervised Teaching–Math; Grades 7–9, Grades 10–12
    MAE 454 (Student Teaching Seminar) _____
14. SSE 327____ SSE 350____
15. LIN 344 (Literary Development) _____
16. Upper-Division Writing Requirement (see Appendix F on Page 22)
    Expository: ____ Expository: ____ Proof:____
17. 1 year language _____

Have all the above courses been taken for a letter grade and completed with grade of C or higher?____