The University of Florida

Department of Mathematics

The Mathematics Major Handbook

2008-2009

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Purpose of this Handbook

This Handbook is a concise, informal guide to the official policies which would lead to graduation with a math major. We have tried to include some practical advice. It should answer most general advising questions for the math major and the prospective math major.

The official record for undergraduate education at the University of Florida is the Undergraduate Catalog found at

http://www.registrar.ufl.edu/catalog

Unlike the information in this Handbook, the University is committed to the information presented there.

The Handbook for Mathematics Majors is published by the Department of Mathematics. Copies of this Handbook are available at

http://www.math.ufl.edu/undergradprog/handbook.pdf

Corrections to this Handbook should be sent to Rick Smith at **rs@math.ufl.edu.**

The information contained in this Handbook applies to the academic year 2008-09 and is accurate and current, to the best of our knowledge as of August 2008. The information contained here is not binding on the University of Florida or the Mathematics Department and should not be construed as constituting a contract with the University of Florida. The University reserves the right to make changes to academic requirements and the calendar in accordance with established procedures.

Advising

Students seeking advice on the mathematics major should consult this Handbook and the pearls of wisdom contained here first. If you still need advice, the department advisors are available with schedules posted at

http://www.math.ufl.edu/undergradprog/advisors.html

Or you may consult the Undergraduate Coordinator whose hours are posted at

www.math.ufl.edu/~rs

Questions concerning University or CLAS requirements should be taken to the CLAS Advising Office in Farrior Building or visit the website:

www.advising.ufl.edu

Quick Reference List of Mathematics Courses Offerings

Relevant for Mathematics Majors
and when they are typically offered

Lower Division

Pre-Calculus and GenEd Classes

MAC 1105 Basic College Algebra (Summer B, restricted to AIM students)
MAC 1114 Trigonometry (Fall, Spring, Summer B)
MAC 1140 Precalculus Algebra (Fall, Spring, Summer B)
MAC 1147 Precalculus: Algebra and Trigonometry (Fall, Spring, Summer B, C)
MGF 1106 Mathematics for Liberal Arts Majors 1 (Fall, Spring, Summer A, B)
MGF 1107 Mathematics for Liberal Arts Majors 2 (Fall, Spring, Summer B)

Calculus and Differential Equations

MAC 2233 Survey of Calculus 1 (Fall, Spring, Summer A, B, C)
MAC 2234 Survey of Calculus 2 (Fall, Spring, Summer C)
MAC 2311 Analytic Geometry and Calculus 1 (Fall, Spring, Summer C)
MAC 2312 Analytic Geometry and Calculus 2 (Fall, Spring, Summer C)
MAC 2313 Analytic Geometry and Calculus 3 (Fall, Spring, Summer C)
MAC 2512 Calculus 2 for Advanced Placement Students (Fall)
MAC 3472 Honors Calculus 1 (Fall, restricted to Honors students)
MAC 3473 Honors Calculus 2 (Fall, Spring, restricted to Honors students)
MAC 3474 Honors Calculus 3 (Fall, Spring, restricted to Honors students)
MAP 2302 Elementary Differential Equations (Fall, Spring, Summer A, B)

Upper Division

3000 Level

MAS 3300 Numbers and Polynomials (Fall, Spring, Summer A, B)
MHF 3202 Sets and Logic (Fall, Spring)
MAD 3107 Discrete Mathematics (irregularly)
MAS 3114 Computational Linear Algebra (Fall, Spring, Summer A, B)
MAE 3811 Mathematics for Elementary School Teachers (Fall, Spring, Summer A)
MTG 3212 Geometry (Spring)
MTG 3214 Euclidean Geometry (Fall)
MHF 3404 History of Mathematics (Summer B)

4000 Level

MAA 4102 Introduction to Advanced Calculus for Engineers and Physical Scientists 1 (Fall, Spring)
MAA 4103 Introduction to Advanced Calculus for Engineers and Physical Scientists 2 (Spring Summer)
MAA 4211 Advanced Calculus 1 (Fall)
MAA 4212 Advanced Calculus 2 (Spring)
MAA 4226 Introduction to Modern Analysis 1 (Fall)
MAA 4227 Introduction to Modern Analysis 2 (Spring)
MAA 4402 Functions of a Complex Variable (Fall, Spring, Summer A)
MAD 4203 Introduction to Combinatorics 1 (Fall)
MAD 4204 Introduction to Combinatorics 2 (Spring)
MAD 4401 Introduction to Numerical Analysis (Fall, Spring)
MAP 4102 Probability Theory and Stochastic Processes 2 (Spring)
MAP 4305 Differential Equations for Engineers and Physical Scientists (Fall, Spring, Summer A)
MAP 4341 Elements of Partial Differential Equations (Spring)
MAP 4413 Fourier Series and Transforms 1 (irregularly)
MAP 4484 Modeling in Mathematical Biology (Spring)
MAS 4105 Linear Algebra 1 (Fall, Spring, Summer C)
MAS 4107 Linear Algebra 2 (irregularly)
MAS 4124 Introduction to Numerical Linear Algebra (Fall)
MAS 4203 Introduction to Number Theory (Spring, Summer B)
MAS 4301 Abstract Algebra 1 (Fall, Spring, Summer C)
MAS 4302 Abstract Algebra 2 (irregularly)
MHF 4102 Elements of Set Theory (Fall)
MHF 4203 Foundations of Mathematics (Spring)
MTG 4302 Elements of Topology 1 (Fall)
MTG 4303 Elements of Topology 2 (Spring)

MAT 4905 Individual Work (Fall, Spring, Summer)
MAT 4930 Special Topics in Mathematics (Fall, Spring, Summer)
MAT 4956 Overseas Studies (Fall, Spring, Summer)

What Do Math Majors Do After Graduation?

Studying Mathematics develops such skills as critical thinking, oral and written communication, arguing logically and rigorously, thinking abstractly, formulating and solving problems, analyzing data, analyzing mathematical models, quantitative and computer proficiency, and the ability to work in groups. Employers value these skills; consequently, math majors find themselves in demand by employers for careers in a wide spectrum of fields. In fact, according to a National Science Foundation survey of recent college graduates, most mathematics majors go on to careers in business, industry, and government.

The mathematics major is broad and flexible. A bachelor's degree in mathematics will prepare you for jobs in statistics, actuarial science, mathematical modeling, cryptography, mathematics education, as well as for graduate school leading to a research career in engineering, mathematics or statistics. A strong background in mathematics is also necessary for research in many areas of computer science and social science. The flexibility of the major allows the student to choose a variety of courses in a secondary area. Mathematics is a discipline, not a single career**.** With a judicious choice of electives, the mathematics curriculum at UF can prepare you for any one of these careers. In the section titled *Course Recommendations for Particular Interests,* some suggestions are made about how to do this.

After graduation a mathematic major might take a job that uses their math major, in an area like statistics, bioinformatics, biomathematics, biostatistics, educational testing and measurement, operations research, epidemiology, public health, public policy, actuary, or mathematics education. Those who enjoy mathematics, but are thinking of pursuing a career as a doctor, lawyer, or businessman should know that professional schools in business, law, and medicine appreciate mathematics majors because of the analytical skills and problem solving developed in the math major courses. The data from the LSAT, MCAT, GMAT, and GRE entrance exams all support this.

For fun you might start out by looking at what Monster.com has for math majors with their major to career converter:

http://content.monstertrak.monster.com/tools/careerconverter/

The mathematics professional societies offer information at these professional organization websites:

American Mathematical Society

www.ams.org/employment/undergrad.html

Mathematical Association of America

www.maa.org/careers

Society for Industrial and Applied Mathematics

www.siam.org/careers

Mathematics has two professional tracks; actuarial science and teaching mathematics.

Actuarial Science

Information about actuarial science can be found at the websites

http://www.BeAnActuary.com and **http://soa.org**

The actuarial science minor at UF is offered through the Statistics Department and information about that program is available at

http://www.stat.ufl.edu/academics/ugrad/ActuarialScience/index.htm

Teaching Mathematics

Students interested in teaching mathematics in secondary education should seek advice in the College of Education about their options on how to be certified to teach high school in the State of Florida. Teaching certification involves several components: a degree in a mathematics related area, practical mentored teaching experience, education classes, and a passing score on the state certification exam.

The College of Education offers the Pathways to Teaching minor to help the prospective teacher to take the needed coursework towards certification.

http://education.ufl.edu/web/?pid=57

UFTeach is a new program designed to get prospective teachers an early experience in the classroom. Those who think they might enjoy teaching and would like to get some teaching experience are encouraged to look into this program at

http://ufteach.clas.ufl.edu/

Graduate Study

Many mathematics majors choose to continue studying in graduate school. There are many different types of graduate programs for which a major in math is good preparation. Some choose to go in another area like statistics, operations research, finance, economics or engineering. Others will choose to continue their studies in graduate school in mathematics. Their goal may be getting an advanced degree in applied mathematics and working in industry or they may be planning to become a college teacher or professor.

Should I Be a Math Major?

The answer to the question of this section is rarely easy and always very specific to the individual. One major consideration for most students is the question of job opportunities after graduation. For a more detailed answer to this question the student should consult the previous section of this Handbook, *What Do Math Majors Do After Graduation*? The point of that section is that *math majors enjoy many and varied employment opportunities*. In this section we will focus more on the aptitude towards mathematics. Here is a little inventory of questions for you to consider. These questions are not about the answer so much as the self-inspection that they are intended to trigger.

1. What has been your mathematical experience so far?

Are you currently taking math classes? Are these among your favorite classes? One would expect that someone considering the math major has been doing well in math classes. As odd as it may seem, this is not always the case. If you have been doing well in Calculus, this is a good sign. It is not a definitive sign. If you have been struggling in Calculus, it is not a good sign. The Mathematics major makes a rather abrupt transition between the lower division courses and the upper division. Upper division courses are proof-oriented, based on derivations from axiom systems, and precise definitions. For most students this level of rigor is new and unexpected. Prospective majors should take one of MAS 3300 or MHF 3202 as soon as possible, so that we can get an early diagnosis about their aptitude for later courses.

2. Are you ready for a mathematical world?

Do you like working on problems and puzzles? Do you like the nuance of an argument? Do you like to think logically about things? Do you enjoy trying to formulate things in mathematical terms? Do you like analogies? Do you like explaining mathematics to other people? Mathematics is full of symbolic formulations, derivations, computations (both by hand and computer), data, abstraction, visualization, problems, communication of ideas, relationships between mathematical objects, analogies, and precision. This is a brief description of the mathematician's world. The further you go with mathematics, the more you will be drawn into this way of working and thinking. While not all math majors will be research mathematicians, others will go into an area like Law where the actual mathematics may not be used, but the discipline is very important.

3. Do you need to know what you will be doing after graduation?

Many students are trying to decide whether to major in math or engineering or possibly another professional area. Since math majors enjoy many of the employment opportunities which are available to professional majors, deciding which major is very personal. Mathematics is a discipline, and as such it is not skill training for a particular vocation. The exceptions to this are the professions of teaching and actuarial science. Professional schools prepare students for rather specific jobs. The Mathematics student learns the discipline of mathematics, which is applicable in many vocations. Math majors get great jobs (if you still do not get this, go back to the

section *What Do Math Majors Do After Graduation?)* Math majors are just not trained for a particular job.

A related question is how badly do you need to be able to tell other people what you will be doing? Some people are uncomfortable saying, "I *could* do this, or this, or this" and have a personal need to be able to say, "I *will* be doing this." For some people, this element of uncertainty is exciting. Others are not willing to start down a path without knowing where it leads. Which kind of person are you?

If you want any easy major, just want to know how to compute something, find analyzing things tiresome, and do not care why something works, then the mathematics major is *not* a good choice for you.

Having taken this little self-assessment you may still feel that you would like more information, we recommend that you go the UF Career Resource Center at the Reitz Union and take some of the personality and aptitude tests there. The web link is

http://www.crc.ufl.edu/

Another career counseling resource is Florida's

http://www.facts.org/

Whatever you learn about yourself in this process is important and should be part of your college experience. If you still think you would like to try the mathematics major, then get ready for the fun and variety of a rich mental world which also happens to be a great way to make a living.

Requirements for the Mathematics Major

The Department of Mathematics offers both the Bachelor of Arts (BA) degree and the Bachelor of Science (BS) degree. Students who plan to attend graduate school in mathematics should consider working toward the BS degree. The specific requirements for the BA and BS degrees are listed below.

Bachelor of Arts (BA) Degree

Core Courses

- Calculus 2 (MAC 2312 or 2512 or 3473),
- Calculus 3 (MAC 2313 or 3474),
- Differential Equations (MAP 2302),
- Numbers and Polynomials (MAS 3300) or Sets and Logic (MHF 3202),
- Linear Algebra 1 (MAS 4105),
- Abstract Algebra (MAS 4301), and
- The sequence Advanced Calculus for Engineers and Physical Scientists 1 and 2 (MAA 4102 and 4103) or the sequence Advanced Calculus 1 and 2 (MAA 4211 and 4212).

The requirement of MAS 3300 or MHF 3202 may be waived for students who present *evidence of significant prior experience in writing proofs of theorems.*

Electives

The four electives must be chosen from the list of approved electives below, and at least one must be a course offered by the Mathematics Department at the 4000-level or above.

Bachelor of Science (BS) Degree

Core Courses

- Calculus 2 (MAC 2312 or 2512 or 3473),
- Calculus 3 (MAC 2313 or 3474),
- Differential Equations (MAP 2302),
- Numbers and Polynomials (MAS 3300) or Sets and Logic (MHF 3202),
- Linear Algebra 1 (MAS 4105),
- Abstract Algebra 1 (MAS 4301), and
- The sequence Advanced Calculus 1 and 2 (MAA 4211 and 4212).

The requirement of MAS 3300 or MHF 3202 may be waived for students who present *evidence of significant prior experience in writing proofs of theorems.*

Electives

The four electives must be chosen from the list of approved electives below, and at least three must be courses offered by the Mathematics Department at the 4000-level or above. It is recommended that majors in the BS program consider additional depth and breadth to their elective studies by taking one of the sequences: Topology (MTG 4302-4303), Combinatorics (MAD 4203-4204) or Foundations (MHF 4102-4203) or completing the Linear Algebra sequence (MAS 4107) or the Abstract Algebra sequence (MAS 4302).

All math majors are encouraged to meet the college distribution requirement in the physical sciences with the sequence PHY 2048-2049 (Physics with Calculus) or the sequence PHY 2060-2061 (Enriched Physics with Calculus). *Math majors also should take no mathematics course at the 3000 level or below that is not on the list of core courses or on the list of approved electives, except with adviser approval.*

Approved Electives for all Mathematics Majors, except as noted

MAD 3107 Discrete Mathematics
MTG 3212 Geometry
MTG 3214 Euclidean Geometry (counts only toward BA degree)
MHF 3404 History of Mathematics
MAA 4226 Introduction to Modern Analysis 1
MAA 4227 Introduction to Modern Analysis 2
MAA 4402 Functions of a Complex Variable
MAD 4203 Combinatorics 1
MAD 4204 Combinatorics 2
MAD 4401 Introduction to Numerical Analysis
MAS 4107 Linear Algebra 2
MAS 4124 Introduction to Numerical Linear Algebra
MAS 4302 Abstract Algebra 2
MAS 4203 Introduction to Number Theory
MAP 4305 Differential Equations for Engineers and Physical Scientists
MAP 4341 Elements of Partial Differential Equations
MAP 4413 Fourier Series and Transforms 1
MAP 4484 Modeling in Mathematical Biology
MAP 4102 Probability and Stochastic Processes 2
MAT 4930 Special Topics in Mathematics (if approved)
MHF 4102 Elements of Set Theory
MHF 4203 Foundations of Mathematics
MTG 4302 Elements of Topology 1
MTG 4303 Elements of Topology 2

Any course offered by the Mathematics Department at the 5000-level or above, and any of the following courses offered outside the mathematics department:

Computer Science Courses
COP 3530 Data Structures and Algorithm
CDA 3101 Introduction to Computer Organization
COP 4600 Operating Systems

Industrial Engineering Courses
ESI 4312 Operations Research 1
ESI 4313 Operations Research 2

Physics Courses
PHY 3063 Enriched Modern Physics
PHY 3221 Mechanics 1
PHY 3323 Electromagnetism 1
PHY 3513 Thermal Physics 1
PHY 4222 Mechanics 2
PHY 4324 Electromagnetism 2
PHY 4422 Optics 1
PHY 4523 Statistical Physics
PHY 4604 Introductory Quantum Mechanics 1
PHY 4605 Introductory Quantum Mechanics 2

Statistics Courses
STA 4321 Mathematical Statistics 1
STA 4322 Mathematical Statistics 2
STA 4210 Regression Analysis
STA 4211 Design of Experiments
STA 4853 Introduction to Time Series and Forecasting

A Semester Plan of Mathematics Courses for the Mathematics Major

Here is a sample semester plan that will work for either the BA or the BS degree leaving the student with plenty of flexibility to explore secondary interests.

Standard Plan

First Year	
Fall	**Spring**
MAC 2311 (Calculus 1) Biological Science Social and Behavioral Science Humanities Elective	MAC 2312 (Calculus 2) Biological Science Composition Humanities Elective
Second Year	
Fall	**Spring**
MAC 2313 (Calculus 3) Physical Science + Science Lab Social and Behavioral Science Humanities Elective	MAP 2302 (Differential Equations) MAS 3300 (Numbers and Polynomials) **or** MHF 3202 (Sets and Logic) Physical Science Composition Social and Behavioral Science
Third Year	
Fall	**Spring**
MAS 4105 (Linear Algebra) Math elective Foreign Language Elective	MAS 4301 (Abstract Algebra 1) Math elective Foreign Language Two electives
Fourth Year	
Fall	**Spring**
MAA 4211 or MAA 4102 (Advanced Calculus 1) Math elective Three electives	MAA 4212 or MAA 4103 (Advanced Calculus 2) Math elective Three electives

This sample plan is a little more aggressive. It is designed for a student who would like to go to graduate school in Mathematics or perhaps enroll in the Combined-Degree Program. The plan is set up to meet the requirements of the BS degree.

Aggressive Plan

First Year	
Fall	**Spring**
MAC 2311 (Calculus 1) Biological Science Social and Behavioral Science Humanities Elective	MAC 2312 (Calculus 2) Biological Science Composition Humanities Elective
Second Year	
Fall	**Spring**
MAC 2313 (Calculus 3) MAS 3300 (Numbers and Polynomials) **or** MHF 3202 (Sets and Logic) Physical Science + Science Lab Social and Behavioral Science Humanities	MAP 2302 (Differential Equations) MAS 4105 (Linear Algebra) Physical Science Composition Social and Behavioral Science
Third Year	
Fall	**Spring**
MAA 4211 (Advanced Calculus 1) MAS 4301 (Abstract Algebra 1) Foreign Language Elective	MAA 4212 (Advanced Calculus 2) Math elective Foreign Language Two electives
Fourth Year	
Fall	**Spring**
MAA 4226 (Modern Analysis 1) or another math elective MAS 5311 (Intro Algebra 1) or another math elective Three electives	MAA 4227 (Modern Analysis 2) or another math elective Math elective Three electives

The CLAS Requirements

Every mathematics major must meet the requirements of the College of Liberal Arts and Sciences. Those requirements are summarized in the catalog at

http://www.registrar.ufl.edu/catalog/programs/las/overview.html

For students who are considering mathematics either by changing majors or as a double major, the CLAS requirements need to be considered. The CLAS ***elective requirements*** are more stringent than the general education requirements.

Composition	6 credits
Mathematical Sciences	6 credits
Humanities	9 credits
Social and Behavioral Sciences	9 credits
Physical Science	6 credits
Biological Science	6 credits
Science Laboratory	1 credit

The degree program must include ***18 hours of electives at the 3000 level or above*** outside the major or the major department. Several 2000-level natural science or mathematical science courses can be used for this requirement. Eligible courses are CHM 2211, 2211L; PHY 2049, 2049L, 2054, 2054L; MAC 2234, 2312, 2313, 2512; MAP 2302; and CGS 2532. Mathematics electives (chosen from the elective list) which are from outside the Mathematics department (Computer Science, Physics, Industrial Engineering or Statistics) can count towards this requirement as well as the mathematics major elective requirement.

CLAS students must also demonstrate proficiency in a ***foreign language***. Proficiency in a foreign language is considered to be the level of skill a student has upon completion of a beginning language sequence at UF. See this webpage and also the catalog page (above) for more information about how to meet this requirement.

www.advising.ufl.edu/information/foreignlang.html

This section is merely to provide an overview of the CLAS requirements. The student should seek the help of an advisor at the Advising Center to make sure that they are correctly meeting the CLAS requirements.

The Difference Between the BA and the BS Degrees

Since the mathematics major can be associated with either the BA or the BS degree, many students ask which degree they should pursue. For the mathematics major at UF the difference in these degrees is entirely in the selection of mathematics courses taken. In mathematics there is no intrinsic difference in the brand of BA or BS, as opposed to a technical or professional area like Computer Science, where an employer might expect the graduate to have a BS. Nevertheless, many students seem to think that the BA in Mathematics is an inferior degree. Should you hold this opinion, be very careful about saying this in the Mathematics Department, as many Mathematics Faculty have a BA in Mathematics. Traditionally, graduates from liberal arts colleges, for example, Harvard College, receive a BA regardless of the major. Try to put the whole "branding" issue aside and decide which of these degrees will best meet your needs. Very shortly after graduation, you will see that no one really cares whether you got a BA or a BS.

The BS in Mathematics is designed to put you on track for graduate school in Mathematics (as opposed to graduate school in Education, Business or Engineering.) The BS *requires* more of the courses which will be most beneficial in preparation for the intense proof-oriented curriculum of graduate school in Mathematics.

The BA in Mathematics offers the greatest flexibility in the choice of electives. The BA allows the student to choose up to three courses from the elective list in areas like Computer Science, Industrial Engineering, Physics, and Statistics. If you are interested in building a secondary specialty using some of the course recommendations given below, the BA offers a way to do this. The BA is also the most efficient way for a student to get a dual degree in mathematics and one of these majors.

The student who wants to maintain the greatest flexibility, to have a secondary specialty, but also keep the option of graduate school in mathematics open should consider the BS degree.

Students who come into the Mathematics program late in their undergraduate career are expected to maintain their graduation horizon. The BA offers more flexibility with course availability and thus may be the only feasible choice.

Academic Learning Compact

The Academic Learning Compact is a commitment by the Mathematics Department to a standard of skill acquisition and a level of uniformity in the major. The mathematics major will develop proficiency in calculus, differential equations, advanced calculus, linear algebra and abstract algebra, and be exposed to several other mathematical areas beyond these core fields. The mathematics major will learn to read and to construct mathematical proofs, to reason in abstract mathematical systems and to use mathematical models. The math major will also acquire the ability to read new mathematics and to formulate mathematical models and arguments. To ensure that this commitment is achieved, before graduating the mathematics major will

1. Be evaluated on certain examination questions in the core upper-division
2. Satisfy the Florida statutory requirements for CLAST.
3. Complete the requirements for either the BA or BS degree given above.

Skills You Will Acquire in the Mathematics Major (Student Learning Outcomes - SLO)

SLO 1: Proficiency in core mathematics fields: calculus, differential equations, advanced calculus, linear algebra and abstract algebra.
SLO 2: Ability to read and to construct mathematical proofs.
SLO 3: Ability to reason in abstract mathematical systems and mathematical models.
SLO 4: Ability to read new mathematics and to formulate mathematical models and arguments.

Courses	Content	Content	Critical Thinking	Communication
	SLO 1	SLO 2	SLO 3	SLO 4
MAA 4102 (BA only)	X	X	X	
MAA 4103 (BA only)	X	X	X	
MAA 4211 (required for BS)	X	X	X	X
MAA 4212 (required for BS)	X	X	X	X
MAC 2312 OR MAC 2512 OR MAC 3473	X			
MAC 2313 OR MAC 3474	X			
MAP 2302	X			
MAS 3300 OR MHF 3202		X	X	X
MAS 4105	X	X	X	X
MAS 4301	X	X	X	X

The assessment portion of the ALC should be invisible to the student, integrated into the course in such a way that the student is not aware that ALC assessment is occurring.

Course Recommendations for Particular Interests

Actuarial Science

Students interested in Actuarial Science should consider the Actuarial Science Minor which is offered through the Statistics Department. The website for this minor is

http://www.stat.ufl.edu/academics/ugrad/ActuarialScience/index.htm

For a Mathematics Major the additional courses for the Actuarial Minor include

STA 4321	Mathematical Statistics 1
STA 4322	Mathematical Statistics 2
STA 4183	Theory of Interest
STA 4210	Regression Analysis
STA 4853	Intro to Time Series and Forecasting
ACG 2021C	Financial Accounting
FIN 3403	Business Finance
ECO 2013	Macroeconomics
ECO 2023	Microeconomics

Of these courses, three of STA 4321, STA 4322, STA 4210, and STA 4853 can be used as electives for the BA degree.

Applied Mathematics

Students interested in Applied Mathematics should learn a computer programming language, either Fortran or C++, in the course CGS 2425. A selection of electives from the following courses is suggested:

MAP 4305	Differential Equations
MAP 4341	Elements of Partial Differential Equations
MAD 4401	Introduction to Numerical Analysis
MAP 4102	Probability Theory and Stochastic Processes
MAP 4413	Fourier Series and Transforms 1
MAP 4484	Modeling in Mathematical Biology
MAD 4203	Combinatorics 1
MAD 4204	Combinatorics 2
STA 4321	Mathematical Statistics 1
STA 4322	Mathematical Statistics 2
STA 4210	Regression Analysis

Computer Science

A student interested in computer science should consider taking these courses. The last three, COP 3520, CDA 3101 and COP 4600 can all be used as Math electives in a BA program.

CIS 3022	Programming for CIS Majors I
CIS 3023	Programming for CIS Majors II
COT 3100	Applications of Discrete Structures
COP 3520	Data Structures and Algorithms
CDA 3101	Introduction to Computer Organization
COP 4600	Operating Systems

Financial Mathematics

Students interested in Financial Mathematics should consider taking some or all of these courses. A selection of three of STA 4321, STA 4322, ESI 4312 and ESI 4313 can be used as electives for the BA degree.

STA 4321	Mathematical Statistics 1
STA 4183	Theory of Interest
MAP 4102	Probability Theory and Stochastic Processes
MAP 4413	Fourier Series and Transforms 1
ACG 2021C	Financial Accounting
FIN 3408	Business Finance
ESI 4312	Operations Research 1
ESI 4313	Operations Research 2

Graduate Study in Mathematics

Students wishing to pursue graduate study in a PhD. program in mathematics should pursue the BS degree and try to complete MAS 4301 and MAA 4211-4212 by the end of their junior years and to include MAS 5311 (Introductory Algebra 1) and MAA 4226 (Modern Analysis 1) among their electives. Generally, they should try to take as much mathematics as possible. These sequences are particularly useful:

MTG 4302-4303	Topology
MAD 4203-4204	Combinatorics
MHF 4102-4203	Foundations

Operations Research

Students interested in Operations Research should learn a computer programming language, either Fortran or C++, in the course CGS 2425. A selection of electives from the following courses is suggested:

STA 4321	Mathematical Statistics 1
STA 4322	Mathematical Statistics 2
STA 4210	Regression Analysis
MAD 4401	Numerical Analysis
MAS 4124	Numerical Linear Algebra
ESI 4312	Operations Research 1
ESI 4313	Operations Research 2

Of these, a selection of any three count as electives for the BA degree. For more information about careers in Operations Research consult the website

http://www.informs.org/

Physics

Mathematics students who are interested in Physics should consider one of the options which would lead to a minor (or double major) in Physics. An example would be

PHY2048	Physics with Calculus 1
PHY2048L	Lab for PHY 2048
PHY2049	Physics with Calculus 2
PHY2049L	Lab for PHY 2049
PHY3101	Introduction to Modern Physics
PHY3513	Thermal Physics 1
PHY3221	Mechanics 1

Statistics

The following courses are suggested for the student interested in statistics. The student who intends to take all of these courses should consider the minor in Statistics.

STA 4321	Introduction to Probability Theory
STA 4322	Introduction to Statistical Theory 2
STA 4211	Design of Experiments
STA 4210	Regression Analysis

Teaching Mathematics in High School

A selection of the mathematics courses listed below would be beneficial for a student who is interested in teaching high school mathematics. The student pursuing teaching certification should also consider either the Pathways to Teaching Minor or the UFTeach option.

MTG 3214	Euclidean Geometry
MTG 3212	Geometry
MAD 3107	Discrete Structures
MHF 3404	History of Mathematics
STA 4321	Probability Theory

Double Major, Dual Degree, and Second Major

In seeking a major beyond the primary major there are several distinctions to be considered. The first is the degree. The degree is either a Bachelor of Arts (BA) or a Bachelor of Science (BS) degree. The second distinction is the college which confers each degree. In the case of Mathematics, one might be receiving the degree from a single college, Liberal Arts and Sciences (CLAS), or CLAS and another college. The terms double major, dual degree, and second major derive from these distinctions. To earn a double major, dual degree, or second major, a student must be certified for and graduate from all undergraduate programs of study at the same time.

Double Major: To double major, both degrees must be the same - either both Bachelor of Arts or both Bachelor of Science - possibly conferred by different colleges. The requirements of both majors and both colleges must be met. Courses used for one major can fulfill College of Liberal Arts and Sciences' electives for the other major, and vice versa. A student completing two majors that have the same degree, B.A. or B.S., will receive a single degree. The transcript will identify the degree and the two majors. To complete two majors for which the degree is the same, students must first be approved to pursue a double major.

Dual Degree: The designation "dual degree" means that a Bachelor of Arts is conferred with one major and a Bachelor of Science is conferred with another. The two majors may or may not both be in the College of Liberal Arts and Sciences. The requirements of both majors and both colleges must be met. Students must first be approved to pursue dual degrees. The student will receive two degrees and the transcript will identify each degree and major.

Second Major: A student completing major and college requirements in one college and the Mathematics major requirements but not the CLAS requirements, will receive a degree from the first college. The transcript will identify the degree from the first college and the majors from both colleges.

Since the mathematics major allows certain courses from Computer Science, Industrial Engineering, Physics and Statistics to be used as mathematics electives, the math major is particularly amenable to an additional major in these areas. Students interested in applying for a double major, dual degree, or second major should consult the UF catalog at

http://www.registrar.ufl.edu/catalog/programs/las/policies.html

Graduate School in Mathematics

Students who want to study mathematics in graduate school should start thinking during their Junior year about these items:

- Undergraduate preparation for graduate school
- Selection of a graduate school
- The application process

The application process begins during the Fall of the Senior year.

Undergraduate preparation for graduate school

In the section *Requirements for the Mathematics Major* the aggressive plan is presented for students who are considering graduate school in mathematics. There are some course selection suggestions in that section as well. At a minimum the student should complete the BS degree requirements. Many schools look at your transcript to see evidence of exposure to graduate level courses.

Selection of a graduate school

The choice of a graduate school is a major step in a career as a mathematician. Selection is a two way process – you have to be accepted in order to select. First decide how many schools you can afford to apply to. Treat the application process like an investment portfolio - have a sure thing, have a long shot, and have some middle of the road chances – diversify. You can learn a lot about schools by talking to professors that you know. Another major resource is the American Mathematical Society website

ams.org

and

http://www.toroidalsnark.net/gradschools.html

You should determine whether a university you are planning to apply to has top-quality tenured faculty members pursuing research in your potential field of specialization. But you do not necessarily have to go to a leading grad school to get a good advisor. There are a number of mathematics departments in this country which may not be at the top overall, but which have top mathematicians who can be excellent thesis advisors.

While it is important to choose a school with strong reputation in your field of interest, it is also important to balance this with the overall breadth of the department. The quality of other graduate students in the program is also very important. During the first few years of graduate study you will learn much from other graduate students, so it is very helpful to have talented peers.

Applying to Graduate School

1. Letters of Recommendation

Ask professors whom you have had in classes and who know you well enough to write about work habits, character and tenacity as well as mathematical talents.

2. Essays

You will be required to write one or two application essays. Typically you will need to describe your academic background, your achievements to date, what experiences led you to want to get a Ph.D. in math, and what areas of research interest you most. Those essays give you an opportunity to explain away possible bad grades, to describe your resolve, and to convince the admissions committee that you not only have mathematical ability, but that you can persevere to finish your dissertation. They want to know that you are not going to grad school just because you could think of nothing better to do, or because you missed the LSAT deadline.

3. Graduate Record Exam (GRE)

Besides recommendations and essays, other criteria for admissions include grades and scores on the ***Graduate Record Examination*** (GRE). Take this seriously, having poor grades in math courses or poor GRE scores can hurt your chances. Most universities require applicants to take two parts of the GRE -- the general and the subject tests. The general part is similar to the SAT. You may not have seen some of the material on the subject test, so you should study up on the test material - you have less than a minute per question. Information on the GRE is available at

`http://www.gre.org`

4. Deadlines

The deadlines for graduate school applications range from late December to early March. Most schools usually require you to complete your application folder in January. The deadlines for fellowship applications start as early as October.

Combined-Degree Program in Mathematics

The Combined Degree Program is a dual enrollment program which allows a superior student to be enrolled as an undergraduate mathematics major and a mathematics graduate student at the same time. The goal of the program is to allow a student to earn a Masters degree in five years. Students in this program may count up to 12 semester hours of approved graduate-level mathematics courses dually as credit towards both the undergraduate and graduate degrees. Typically, for a master's degree in mathematics, students in this program would follow the aggressive semester plan given in the section on *Requirements of the Mathematics Major.*

Entering the program the student should have

1. Completed the Mathematics major requirements of the BS degree by the end of their junior year. From a practical standpoint this usually means that the student is taking MAC 2313 and MAP 2302 during their freshman year.
2. Taken the GRE, completed an application with references to the UF Graduate School, and been accepted into Graduate School.
3. Started one of the Mathematics core graduate sequences, either MAS 5311-5312 (Introductory Algebra) or MAA 5228-5229 (Modern Analysis) and another graduate mathematics course by the Fall of their senior year.

The graduate courses taken will count both towards the BS and a Masters degree. After undergraduate graduation, the student should be able to complete a Masters degree with one additional year of graduate study.

General information about this program, including admission requirements, is available at

www.admissions.ufl.edu/ugrad/combdegree.html

Students considering this program should consult, in person, with an academic advisor in person. To obtain an application form visit

www.math.ufl.edu/undergradprog/combined_degree_application-2006.pdf

Practical Advice Concerning the Combined-Degree Program

This program works very well for a student who would like to get a quicker Masters Degree (saves one year; one less year as a Gator, which is inconceivable) and start into the work force. The student who aspires to a PhD in Mathematics is not particularly well served by this program. Mathematicians, if they have a Masters Degree at all, got it from the same institution as their PhD. As a result, there is something of a stigma on an application to a PhD program which already shows a Masters Degree. A student in a PhD program is not usually too concerned about accumulating credit hours towards graduation, as writing the dissertation is a much bigger issue. So the jump start of one year is not that significant. We recommend that the student who plans to apply for a PhD program to simply take graduate courses as an undergraduate without entering Graduate School or getting the Masters degree.

Transferring into the Mathematics Major

Switching from another UF major
UF students who are considering a switch into the Mathematics major in their first two years, should meet critical tracking with the Mathematics major. Students with 60 hours or more should have completed the courses MAC 2311, MAC 2312, MAC 2313 and MAP 2302. Students with 90 or more hours are unlikely to be approved for a change of major.

Transferring from a Florida Community College
To be accepted into the Mathematics major a transfer student will have completed the courses MAC 2311, MAC 2312, MAC 2313 and MAP 2302. The transfer student will immediately take either MAS 3300 or MHF 3202 in preparation for the upper division mathematics core classes. The student who wishes to start taking electives right away has limited choices. Most upper division courses carry a pre-requisite of Linear Algebra. There are several elective courses that are available to the transfer student which do not have this pre-requisite. Those are MAA 4402, MAP 4484, MAS 4203, and STA 4321 (the pre-req for this course is waived for math majors who visit the Statistics Department for registration in this course.)

Four year Institutions
Students transferring from a four-year institution should immediately investigate which mathematics courses taken at the previous institution can be substituted for credit at UF. A student transferring into the math major should be on-track with the math major at UF. The suggested schedule of courses for math majors above indicates where a transfer should be.

A word of warning: MAS 4105 is a high level Linear Algebra class that is unlike the Linear Algebra taught at many other schools. If you have taken Linear Algebra previously, the Undergraduate Coordinator will evaluate your course relative to MAS 4105. Generally, you should be prepared to take MAS 4105 at UF.

Transient Study

UF students have the opportunity to study away from UF at other academic institutions. A student who is matriculated at UF but taking courses at another institution is referred to as a *transient student.* In order to be assured that the transient student will receive credit at UF for courses taken away from UF, the student should always process the *transient student form* prior to taking the course away from UF.

The amount of course work taken away from UF while pursing a UF degree is regulated by UF rules. It is required that the last 30 hours of the undergraduate program be spent in residence at UF. Generally speaking, if a mathematics student is going to be spending substantial time at another institution, they should consider getting their degree from that institution. *The mathematics major is expected to take the upper division core major courses: Linear Algebra, Abstract Algebra, Advanced Calculus 1 and 2, at UF.* These are the courses that are common to all math majors and most define the experience of the mathematics major at UF. The upper division transient student might consider taking mathematics electives at another institution with approval of the Undergraduate Coordinator.

Study Abroad

Mathematics majors are encouraged to study abroad to broaden their educational experience. Students can meet requirements such as General Education, CLAS distribution, foreign language, certain courses in the major, summer term enrollment and UF residency. Information is available at the International Center or the website

`http://www.ufic.ufl.edu`

It is difficult to match courses offered at foreign institutions with those offered at US institutions. Term lengths, background requisite knowledge, and grading expectations at those schools are often very different than at UF. For this reason international courses are not usually substituted for the mathematics major upper division core course requirement.

Study at another US institution

Study at another US institution would typically be for someone who is away for the summer, on an internship, or possibly needs to be near family for a short period of time. As mentioned above, UF math majors are expected to complete their core courses at UF. Transient courses which substantially match mathematics *electives* can be taken at another institution with the prior approval of the Undergraduate Coordinator.

Resources, Opportunities, Competitions

Graduating with Honors

There are three levels of honors, *cum laude* (honors), *magna cum laude* (high honors), and *summa cum laude* (highest honors.) *Cum laude* is awarded to a UF student with a 3.5 GPA earned as an upper-division student. This is standard across UF. The award of *magna cum laude* and *summa cum laude* varies according to departmental criteria. For each of these distinctions the Mathematics Department requires an undergraduate thesis. Students interested in high honors should consult the document *Guidelines for Graduation with Honors in Mathematics* at

www.math.ufl.edu/undergradprog/honors_guidelines-web.pdf

Before considering an undergraduate thesis:

1. No honors are given unless your GPA is at least 3.5. Do not start down this path without meeting this requirement.
2. You will need an advisor. Talk to someone you know and have taken a course with. They will have a good idea of your ability and background knowledge.
3. Plan two semesters in advance. You will need one semester to learn the background on your topic and do your research. It is nearly impossible to complete a thesis in a single semester. This is not just another term paper.
4. You will need a second semester to write up your results (the process of properly writing results is really a part of the research), to get your advisors approval, and to submit the thesis.
5. The thesis must be submitted to the Undergraduate Coordinator and to the CLAS Advising Office. Use the *Thesis Submission Form* found at:

http://www.honors.ufl.edu/forms/thesis.pdf

University Scholars Program

The University Scholars Program is an opportunity for a UF undergraduate to get a taste of research while being mentored by a UF faculty member. Details about the program can be found at

www.scholars.ufl.edu

Pi Mu Epsilon

Pi Mu Epsilon is the undergraduate mathematics club. The club meets monthly typically with a speaker who addresses either a topic in mathematics or career opportunities in mathematics. Meeting announcements are sent out on the Mathematics majors email list. Information is available at

http://www.math.ufl.edu/~keating/pme.html

Putnam Competition

The William Lowell Putnam Mathematical Competition is given once each year - usually the first Saturday in December. It is given at universities across the U.S. and Canada to undergraduates. A student may take this exam at most 4 times.

The examination is constructed to test originality as well as technical competence. It is expected that the contestant will be familiar with the formal theories embodied in undergraduate mathematics. Questions are included that cut across various disciplines, and self-contained questions that do not fit into any of the usual categories may be included. The Mathematics Department sponsors a Putnam team each year in this competition. Information about the UF Putnam team is at

http://www.math.ufl.edu/~keating/putnam

Copies of recent exams in various formats with solutions can be found at these websites:

http://www.unl.edu/amc/a-activities/a7-problems/putnam

http://www.math.niu.edu/~rusin/problems-math

Research Opportunities for Undergraduates

The National Science Foundation has sponsored Summer research activities for undergraduate mathematics majors at several major universities. Information on these Projects is available at

http://www.nsf.gov/crssprgm/reu/reu_contacts.jsp

Robert Long Prize

The Robert Long Prize is awarded to the winner of a written essay competition. Professor Robert Long had a particularly keen interest in the history of mathematics. The essay should address a topic in the history of mathematics. The competition is organized each Spring and is open to all undergraduate majors.

Kermit Sigmon Award

Professor Kermit Sigmon gave selflessly of himself to the undergraduate program and to the service of the department. The Kermit Sigmon Award is given annually to the undergraduate mathematics student who best exemplifies that combination of both scholarship and service as represented in Professor Sigmon's life.

Course Descriptions

MAA 4102 Intro to Advanced Calculus for Engineers and Physical Scientists 1
Credits: 3; Prereq: grade of C or better in MAC 2313 or MAC 3474 and in MAS 4105 or MAS 3114.
Theory of real numbers, functions of one variable, sequences, limits, continuity and differentiation; continuity and differentiability of functions of several variables. MAA 4102 is not recommended for students who plan to do graduate work in mathematics; these students should take MAA 4211. (Note: credit will be given for at most one of MAA 4102, MAA 4211 and MAA 5104.)

MAA 4103 Intro to Advanced Calculus for Engineers and Physical Scientists 2
Credits: 3; Prereq: grade of C or better in MAA 4102.
A continuation of MAA 4102. Theory of integration, transcendental functions and infinite series. MAA 4102 is not recommended for students who plan to do graduate work in mathematics; these students should take MAA 4212. (Note: Credit will be given for, at most, one of MAA 4103, MAA 4212 and MAA 5105.)

MAA 4211 Advanced Calculus 1
Credits: 3; Prereq: grade of C or better in MAS 4105.
An advanced treatment of limits, differentiation, integration, series; calculus of functions of several variables. (Note: Credit will be given for, at most, one of MAA 4211, MAA 4102 and MAA 5104.)

MAA 4212 Advanced Calculus 2
Credits: 3; Prereq: grade of C or better in MAA 4211, taken the previous semester.
A continuation of MAA 4211. (Note: Credit will be given for, at most, one of MAA 4212, MAA 4103 and MAA 5105.)

MAA 4226 Introduction to Modern Analysis 1
Credits: 3; Prereq: grade of C or better in MAA 4212.
Topology of metric spaces, numerical sequences and series, continuity, differentiation, the Riemann-Stieltjes integral, sequences and series of functions, the Stone-Weierstrass theorem, functions of several variables, Stokes' theorem and the Lebesgue theory. (Note: Credit will be given for, at most, one of MAA 4226 and MAA 5228.)

MAA 4227 Introduction to Modern Analysis 2
Credits: 3; Prereq: grade of C of better in MAA 4226, taken the previous semester.
A continuation of MAA 4226. (Note: Credit will be given for, at most, one of MAA 4227 and MAA 5229.)

MAA 4402 Functions of a Complex Variable
Credits: 3; Prereq: grade of C or better in MAC 2313 (or MAC 3474) and in MAP 2302. Complex numbers, analytic functions, Cauchy-Riemann equations, harmonic functions, elementary functions, integration, Cauchy-Goursat theorem, Cauchy integral formula, infinite series, residues and poles, conformal mapping. (Note: Credit will be given for, at most, one of MAA 4402 and MAA 5404.)

MAC 1105 Basic College Algebra
Credits: 3. Entry-level algebra for college students.

MAC 1114 Trigonometry
Credits: 2. Exponential and logarithmic functions, trigonometry, and analytic and additional applications of trigonometry.

MAC 1140 Precalculus Algebra
Credits: 3. College algebra, functions, coordinate geometry, exponential and logarithmic functions.

MAC 1147 Precalculus: Algebra and Trigonometry
Credits: 4. College algebra, functions, coordinate geometry, exponential and logarithmic functions, and trigonometry. This fast-paced course is designed as a review of algebra and trigonometry to prepare the student for calculus. This course assumes prior knowledge of intermediate algebra (Algebra 2) and trigonometry.

MAC 2233 Survey of Calculus 1
Credits: 3; Prereq: Any of the following: minimum acceptable score on the Calculus Readiness Assessment; grade of C in a MAC course numbered 1140 or higher; AP credit for MAC 2311; or IB credit for a MAC course numbered 1140 or higher. Any course grades, AP or IB scores used to meet this prerequisite must be on file at UF by registration.
A geometric and heuristic approach to calculus; differentiation and integration of simple algebraic and exponential functions; applications to graphing, marginal analysis, optimization, areas and volumes.

MAC 2234 Survey of Calculus 2
Credits: 3; Prereq: grade of C or better in MAC 2233 or the equivalent.
Sequences, geometric and Taylor series; systems of linear equations, Gaussian elimination, matrices, determinants and vectors; partial differentiation, multiple integrals; applications to marginal analysis, least-squares and Lagrange multipliers.

MAC 2311 Analytic Geometry and Calculus 1
Credits: 4; Prereq: Any of the following: minimum acceptable score on the Calculus Readiness Assessment; grade of C in a MAC course numbered 1140 or higher; AP credit for MAC 2311; or IB credit for a MAC course numbered 1147 or higher. Any course grades, AP or IB scores used to meet this prerequisite must be on file at UF by registration.
Introduction to analytic geometry; limits; continuity; differentiation of algebraic, trigonometric, exponential and logarithmic functions; applications of the derivative; inverse trigonometric functions; differentials; introduction to integration; and the fundamental theorem of calculus. (Note: Credit will be given for, at most, one of MAC 2233, MAC 2311 and MAC 3472.)

MAC 2312 Analytic Geometry and Calculus 2
Credits: 4; Prereq: grade of C or better in MAC 2311 or MAC 3472.
Techniques of integration; applications of integration; differentiation and integration of inverse trigonometric, exponential and logarithmic functions; sequences and series. (Note: Credit will be given for, at most, one of MAC 2312, MAC 2512 and MAC 3473.)

MAC 2313 Analytic Geometry and Calculus 3
Credits: 4; Prereq: grade of C or better in MAC 2312 or MAC 2512 or MAC 3473.
Solid analytic geometry, vectors, partial derivatives and multiple integrals. (Note: Credit will be given for, at most, one of MAC 2313 and MAC 3474.)

MAC 2512 Calculus 2 for Advanced Placement Students
Credits: 4; Prereq: Advancement Placement credit for MAC 2311.
A calculus course for entering freshmen who have Advanced Placement Calculus AB credit for MAC 2311. MAC 2512 covers those topics in MAC 2311 and MAC 2312 not included or only partially covered in the AP Calculus AB curriculum. Some topics from the AP curriculum are reviewed briefly in the first part of the semester. The combination of AP Calculus AB and MAC 2512 has the same content as the sequence MAC 2311-2312. Calculus 2 topics to which the student has been exposed in AP Calculus AB are covered more quickly in MAC 2512 than in MAC 2312. (Note: Credit will be given for, at most, one of MAC 2312, MAC 2512, and MAC 3473.)

MAC 3472 Honors Calculus 1
Credits: 4; Prereq: strong background in precalculus.
The topics covered in the MAC 3472/3473/3474 sequence closely parallel those covered in MAC 2311/2312/2313 but are treated in greater depth. (Note: Credit will be given for, at most, one of MAC 2311 and MAC 3472.)

MAC 3473 Honors Calculus 2
Credits: 4; Prereq: grade of C or better in MAC 3472 or MAC 2311.
A continuation of MAC 3472. (Note: Credit will be given for, at most, one of MAC 2312, MAC 2512 and MAC 3473.)

MAC 3474 Honors Calculus 3
Credits: 4; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473.
A continuation of MAC 3473. (Note: Credit will be given for, at most, one of MAC 2313 and MAC 3474.)

MAD 3107 Discrete Mathematics
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473.
Logic, sets, functions. Algorithms and complexity; integers and algorithms. Mathematical reasoning and induction. Counting principles; permutations and combinations; discrete probability. Advanced counting techniques and inclusion-exclusion.

MAD 4203 Introduction to Combinatorics 1
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473. Some experience with theorems and proofs is recommended.
Permutations and combinations, binomial coefficients, inclusion-exclusion, recurrence relations, Fibonacci sequences, generating functions and graph theory.

MAD 4204 Introduction to Combinatorics 2
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473. Some experience with theorems and proofs is recommended.
Matching theory, block designs, finite projective planes and error-correcting codes. This course does not require the student to have taken MAD 4203.

MAD 4401 Introduction to Numerical Analysis
Credits: 3; Prereq: experience with a scientific programming language and a grade of C or better in MAS 3114 or MAS 4105.
Numerical integration, nonlinear equations, linear and nonlinear systems of equations, differential equations and interpolation.

MAE 3811 Mathematics for Elementary School Teachers 2
Credits: 3; Prereq: passing score on the MAE 3811 Prerequisite Exam. Refer to www.math.ufl.edu/course_guides/mae/3811.html.
Properties of and operations with rational numbers; ratio; proportion; percentages; an introduction to real numbers; elementary algebra; informal geometry and measurement; and an introduction to probability and descriptive statistics. Note: This course is open only to students whose majors are in the College of Education.

MAP 2302 Elementary Differential Equations
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473.
First-order ordinary differential equations, theory of linear ordinary differential equations, solution of linear ordinary differential equations with constant coefficients, the Laplace transform and its application to solving linear ordinary differential equations.

MAP 4102 Probability Theory and Stochastic Processes 2
Credits: 3; Prereq: grade of C or better in STA 4321.
Random walks and Poisson processes, martingales, Markov chains, Brownian motion, stochastic integrals and Ito's formula.

MAP 4305 Differential Equations for Engineers and Physical Scientists
Credits: 3; Prereq: grade of C or better in MAP 2302 and in either MAS 3114 or MAS 4105.
This is a second course in differential equations. Topics are systems of linear differential equations, stability theory and phase plane analysis, power series solutions of differential equations, Sturm-Liouville boundary-value problems and special functions. (Note: Credit will be given for, at most, one of MAP 4305 and MAP 5304.)

MAP 4341 Elements of Partial Differential Equations
Credits: 3; Prereq: grade of C or better in MAP 2302 and MAP 4305.
Introduction to second-order linear partial differential equations (heat, wave and Laplace equations), separation of variables in PDEs, Sturm-Liouville eigenvalue problems, method of eigenfunction expansions (Fourier analysis) and Green's functions. Possible introduction to first-order PDEs and the method of characteristics. (Note: Credit will be given for, at most, one of MAP 4341 and MAP 5345.)

MAP 4413 Fourier Series and Transforms 1
Credits: 3; Prereq: grade of C or better in MAC 2313 (or MAC 3474) and MAP 2302; MAP 4305 recommended.
Introduction to linear systems and transforms; Laplace, Fourier and Z transforms and their mutual relationship; convolutions. Operational calculus; computational methods including the fast Fourier transform; second-order stationary processes and their autocorrelation functions; and problems of interpolation, extrapolation, filtering and smoothing of second-order stationary processes.

MAP 4484 Modeling in Mathematical Biology
Credits: 3; Prereq: grade of C or better in MAP 2302.
Mathematical models of biological systems. Topics include models of growth, predator-prey populations, competition, the chemostat, epidemics, excitable systems and analytical tools such as linearization, phase-plane analysis, Poincare-Bendixson theory, Lyapunov functions and bifurcation analysis.

MAS 3114 Computational Linear Algebra
Credits: 3; Prereq: experience with a scientific programming language and a grade of C or better in MAC 2312 (or MAC 2512 or MAC 3473).
Linear equations, matrices and determinants. Vector spaces and linear transformations. Inner products and eigenvalues. This course emphasizes computational aspects of linear algebra.

MAS 3300 Numbers and Polynomials
Credits: 3; Prereq: grade of C or better in a UF math course at the 2000 level or above; this requirement is waived for transfer students with junior standing.
This course emphasizes theorems and proofs. Topics include algebraic and order properties of the real numbers; introduction to number theory; rational numbers and their decimal expansions; uncountability of the real numbers; complex numbers, irreducible polynomials over the integral, rational, real and complex numbers; and elementary theory of equations. Taking one (but not both) of MAS 3300 and MHF 3202 is required of mathematics majors. MAS 3300 is also particularly useful for prospective secondary-school mathematics teachers. (M) (MR)

MAS 4105 Linear Algebra 1
Credits: 4; Prereq: grade of C or better in MAC 2313 or MAC 3474 and in MAS 3300 or MHF 3202.
Linear equations, matrices, vector spaces, linear transformations, determinants, eigenvalues and inner-product spaces. This course includes both theory and computational skills. The student is expected to develop the ability to reason through, and coherently write up, proofs of theorems. For math majors, this course serves as a transition from a study of techniques into more conceptual math; for engineering and science majors, it serves also as a coherent foundation in linear algebra.

MAS 4107 Linear Algebra 2
Credits: 3; Prereq: grade of C or better in MAS 4105.
Further topics in linear algebra.

MAS 4124 Introduction to Numerical Linear Algebra
Credits: 3; Prereq: experience with a scientific programming language and a grade of C or better in MAS 3114 or MAS 4105.
Topics in linear algebra most useful in applications with emphasis on the numerical methods involved: direct and iterative solutions to systems of linear equations; matrix norms; Householder transformations; singular value decomposition; least squares and the generalized inverse; QR method for computing eigenvalues; condition number of linear systems and eigensystems.

MAS 4203 Introduction to Number Theory
Credits: 3; Prereq: grade of C or better in MAC 2312 or MAC 2512 or MAC 3473; MAS 3300 recommended.
An introduction to elementary number theory and its applications to computer science and cryptology. Divisibility, primes, Euclidean Algorithm, congruences, Chinese Remainder Theorem, Euler-Fermat Theorem and primitive roots. Selected applications to decimal fractions, continued fractions, computer file storage and hashing functions, and public-key cryptography. (M)

MAS 4301 Abstract Algebra 1
Credits: 3; Prereq: grade of B or better in MAS 3300 or MHF 3202, or a grade of C or better in MAS 4105.
Sets and mappings, groups and subgroups, homomorphisms and isomorphisms, permutations, rings and domains, arithmetic properties of domains, and fields. This course requires facility in writing proofs.

MAS 4302 Abstract Algebra 2
Credits: 3; Prereq: grade of C or better in MAS 4301.
Further topics in abstract algebra.

MAT 4905 Individual Work
Credits: 1 to 3; can be repeated for up to 10 credits. Prereq: grade of C or better in MAC 2313 (or MAC 3474) and undergraduate coordinator permission. For special topics not obtainable in the regular course offerings.

MAT 4930 Special Topics in Mathematics
Credits: 1 to 3; can be repeated for up to 16 credits. Prereq: undergraduate coordinator permission. Qualified undergraduates will take part in seminars or classes on special topics.

MAT 4956 Overseas Studies
Credits: 1 to 15; can be repeated with change in topic up to 15 credits. Prereq: Permission of undergraduate adviser. This revolving topics course provides a mechanism by which course work taken abroad as part of an approved student program can be recorded on the transcript and counted toward UF graduation.

MGF 1106 Mathematics for Liberal Arts Majors 1
Credits: 3; Students who have received credit for MGF 1202 will not receive credit for MGF 1106.
This course is designed for non-science and non-business majors who need to fulfill their writing and math requirements and their General Education math requirements. The course includes an introduction to set theory, logic, number theory, probability, statistics, graphing and linear programming.

MGF 1107 Mathematics for Liberal Arts Majors 2
Credits: 3.
A general education course that demonstrates the beauty and utility of mathematics. Topics include financial management, linear and exponential growth, mathematics in the arts and discrete mathematics. This course does not require the student to have taken MGF 1106.

MHF 3202 Sets and Logic
Credits: 3; Prereq: grade of C or better in a UF math course at the 2000 level or above. Examples of sets, operations on sets, set algebra, Venn diagrams, truth tables, tautologies, applications to mathematical arguments and mathematical induction. Taking one (but not both) of MAS 3300 and MHF 3202 is required of mathematics majors. MHF 3202 can also be very useful for prospective and in-service secondary and middle school teachers.

MHF 3404 History of Mathematics
Credits: 3; Prereq: grade of C or better in MAS 2312, MAC 2512 or MAC 3473.
An introduction to the history of selected mathematical topics.

MHF 4102 Elements of Set Theory
Credits: 3; Prereq: grade of C or better in MAS 4105.
The basic axioms and concepts of set theory. Students present proofs. (Note: Credit will be given for, at most, one of MHF 4102 and MHF 5107.)

MHF 4203 Foundations of Mathematics
Credits: 3; Prereq: grade of C or better in MAS 4105.
Models and proofs. Foundations of the real and natural numbers, algorithms, Turing machines, undecidability and independence. Examples and applications in algebra, analysis, geometry and topology. (Note: Credit will be given for, at most, one of MHF 4203 and MHF 5207.)

MTG 3212 Geometry
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473.
An axiomatic treatment of topics in Euclidean, non-Euclidean, projective geometry and (time permitting) fractal geometry. This course is particularly useful for prospective secondary-school mathematics teachers.

MTG 3214 Euclidean Geometry
Credits: 3; Prereq: grade of C or better in MAC 2312, MAC 2512 or MAC 3473.
Axiomatic structure of Euclidean geometry: congruence, parallelism, area, similarity, circles, polygons, medians, constructions, solid geometry, spherical and hyperbolic geometry. This course is particularly useful for prospective secondary-school mathematics teachers.

MTG 4302 Elements of Topology 1
Credits: 3; Prereq: grade of C or better in MAS 4105.
MTG 4302 and MTG 5316.)

MTG 4303 Elements of Topology 2
Credits: 3; Prereq: grade of C or better in MTG 4302.
Continuation of MTG 4302. (Note: Credit will be given for, at most, one of MTG 4303 and MTG 5317.)

Mathematics Faculty

Alladi, Krishnaswami Number Theory (UCLA, 1978)	**Andrews, George E.** *Distinguished Visiting Professor* Number Theory (Evan Pugh Professor, Penn. State)
Berkovich, Alexander Mathematical Physics, q-series (New York University, 1987)	**Block, Louis** Dynamical Systems (Northwestern University, 1973)
Bóna, Miklós Combinatorics (MIT, 1997)	**Boyland, Philip** Dynamical Systems (University of Iowa, 1983)
Brooks, James Probability Theory, Stochastic Processes (Ohio State University, 1964)	**Cenzer, Douglas** Mathematical Logic, Computability (University of Michigan, 1972)
Chen, Yunmei Nonlinear equations, harmonic maps (Fundan University, Shanghai, 1985)	**Crew, Richard** Arithmetic algebraic geometry (Princeton University, 1981)
DeLeenheer, Patrick Mathematical Biology, Control Theory (Ghent University, Belgium, 2000)	**Dranishnikov, Alex** Geometric topology (Moscow State University, 1983)
Edwards, Bruce Numerical techniques in differential equations (Dartmouth College, 1976)	**Ehrlich, Paul** Differential geometry, General relativity (SUNY, Stony Brook, 1974)
Garvan, Frank Number Theory, Combinatorics (Pennsylvania State University, 1986)	**Glover, Joseph** Probability Theory, Financial Mathematics (University of California, San Diego, 1978)
Gopalakrishnan, Jayadeep Numerical analysis, finite element methods, (Texas A&M, 1999)	**Groisser, David** Differential geometry, Mathematical physics (Harvard University, 1983)
Hager, William Numerical analysis, optimization (MIT, 1974)	**Jury, Michael** Operator theory, operator algebras (Washington University, 2002)
Keating, Kevin Number theory, Arithmetic algebraic geometry (Harvard University, 1987)	**James Keesling** Topology, dynamical systems, biomathematics (University of Miami, 1968)
King, Jonathan Ergodic theory, Combinatorics (Stanford University, 1984)	**Klauder, John** Chaotic dynamics, Quantum theory (Princeton University, 1959)
Larson, Jean Set theory, Foundations, Combinatorics (Dartmouth College, 1972)	**Levin, Norman** Number theory, Algebraic geometry (University of Chicago, 1996)

Mair, Bernard Medical imaging, Potential theory (McGill University, 1983)	**Martcheva, Maia** Mathematical biology, Population dynamics (Purdue University, 1998)
Martinez, Jorge Ordered algebraic structures (Tulane University, 1969)	**McCullough, Scott** Operator theory, Functional analysis (University of California, San Diego, 1987)
Mitchell, William Set theory, Logic (University of California, Berkeley, 1970)	**Olson, Tim** Approximation theory, Wavelets, Imaging (Auburn University, 1991)
Pilyugin, Sergei Differential equations, Dynamical systems (Emory University, 1997)	**Rao, Murali** Probability theory, Potential theory (Tata Institute, 1963)
Robinson, Paul Symplectic geometry(University of Warwick, 1985)	**Rudyak, Yuli** Geometry, Topology (Moscow State University, 1975)
Shabanov, Sergei Computational electromagnetism, Quantum physics (State University of St.-Petersburg, 1988)	**Shen, Li-Chien** Differential equations, Function theory (University of Wisconsin-Madison, 1981)
Sin, Peter Algebra, Finite groups (Oxford University, 1986)	**Smith, Rick** Mathematical logic, Computability theory (Pennsylvania State University, 1979)
Summers, Stephen Mathematical physics, Operator algebras, Probability theory (Harvard University, 1979)	**Thompson, John** Group theory *Graduate Research Professor* (University of Chicago, 1959)
Tiep, Pham.Huu Finite groups, Representation theory (Moscow State University, 1989)	**Turull, Alexandre** Algebra, Group theory, Representation theory (University of Chicago, 1982)
Vince, Andrew Combinatorics, Graph theory (University of Michigan, 1981)	**Walsh, Thomas** Singular integrals (University of Chicago, 1969)
Yan, Liqing Combinatorics, Invariant theory (Purdue University, 2000)	**Zapletal, Jindrich** Set theory (Pennsylvania State University, 1995)