Mathematics and Statistics

Louis Roder Tcheugoue Tebou, *Professor and Chair*
Florence George, *Associate Professor and Director of the Statistics Division*
Dongmei An, *Associate Teaching Professor*
Leonid Bekker, *Teaching Professor*
Hakima Bessaih, *Professor*
Umut Caglar, *Associate Teaching Professor*
Walter Carballosa, *Assistant Teaching Professor*
Chongsheng Cao, *Professor*
Zhenmin Chen, *Professor (In Memoriam)*
Zhongxue Chen, *Professor*
Michael Davidson, *Assistant Teaching Professor*
Laura De Carli, *Professor*
Tedi Draghici, *Associate Professor*
Ian Dryden, *Professor*
Julian Edward, *Professor*
Anna Fino, *Professor*
Domitila Fox, *Teaching Professor*
Edgar Fuller, *Professor and Director of the Center for the Transformation of Teaching Mathematics*
Ciprian Gal, *Associate Professor*
Maydelin Galvez, *Assistant Teaching Professor*
Gauri L. Ghai, *Associate Professor and Advisor*
Deborah Goldwasser, *Assistant Teaching Professor*
Gueo Grantcharov, *Professor*
Sneh Gulati, *Professor*
Yanqiu Guo, *Assistant Professor*
Kathleen Guy, *Associate Teaching Professor*
Lotfi Hermi, *Assistant Teaching Professor*
Jerry Hower, *Associate Teaching Professor*
Kai Huang, *Associate Professor*
George Kafkoulis, *Associate Professor*
Golam Kibria, *Professor*
Solange Kouemou, *Teaching Professor*
Mark Leckband, *Professor Emeritus*
Thomas Leness, *Professor*
Bao Qin Li, *Professor*
Xiaosheng Li, *Associate Professor*
Dane McGuckian, *Teaching Professor*
Lakshmy Menon, *Associate Teaching Professor*
Idris Mercer, *Assistant Teaching Professor*
Roneet Merkin, *Associate Teaching Professor*
Abdelhamid Meziani, *Professor*
Jie Mi, *Professor*
Dane McGuckian, *Teaching Professor*
Lakshmy Menon, *Associate Teaching Professor*
Idris Mercer, *Assistant Teaching Professor*
Roneet Merkin, *Associate Teaching Professor*
Abdelhamid Meziani, *Professor*
Jie Mi, *Professor*
Ada Monserrat, *Associate Teaching Professor*
Gisela Muniz, *Assistant Teaching Professor*
Kolapo Oluwo, *Assistant Teaching Professor*
Sergio Perez, *Associate Teaching Professor*
Shivanni Ramhit, *Associate Teaching Professor*
Taje Ramsamujh, *Associate Professor*
Laura Reisert, *Associate Teaching Professor*
Alireza Rostamian, *Teaching Professor*
Svetlana Roudenko, *Professor and Graduate Program Director*
Philippe Rukimbira, *Professor*
Samuel S. Shapiro, *Professor Emeritus*
Robert Storfer, *Associate Teaching Professor*
Yuanchang Sun, *Associate Professor*
Theodore Tachim Medjo, *Professor*
Enrique Villamor, *Professor*
Wei Wang, *Associate Professor*
Zhongming Wang, *Associate Professor*
Anna Wlodarczyk, *Teaching Professor*
Wensong Wu, *Associate Professor*
Yi Zhi Yang, *Associate Teaching Professor*
Mirroslav Yotov, *Teaching Professor*
Hassan Zahedi-Jasbi, *Associate Professor*
John Zweibel, *Associate Professor, Advisor and Undergraduate Director*

Bachelor of Science in Mathematical Sciences

The Bachelor's degree in Mathematical Sciences emphasizes a deeper study of mathematics and statistics. A student planning to continue into graduate study should major in Mathematical Sciences.

Degree Program Hours: 120

Lower Division Preparation

Students admitted to the university are admitted directly to their chosen major. Students are expected to make good progress based on critical indicators, such as GPA in specific courses or credits earned. In cases where students are not making good progress, a change of major may be required. Advisors work to redirect students to more appropriate majors when critical indicators are not met.

Common Prerequisite Courses and Equivalencies

FIU Course(s)	Equivalent Course(s)
MAC 2311	MACX311
MAC 2312	MACX312
MAC 2313	MACX313
MAP 2302*	MAPX302*
COP 2210 or COP 2250	COPXXXX[1]
BSC 2010, BSC 2010L, or BSC 2011, BSC 2011L, or	BSCXXXX/XXXXL[2] or
CHM 1045, CHM 1045L, or CHM 1046, CHM 1046L, or	CHMXXXX/XXXXL[2] or PHYXXXX/XXXXL[2]
PHY 2048, PHY 2048L, or PHY 2049, PHY 2049L	

**Not required for Statistics Majors*
[1]a scientific programming course designed for computer science majors.
[2]one laboratory based science course designed for science majors.

Courses which form part of the statewide articulation between the State University System and the Florida College System will fulfill the Lower Division Common Prerequisites.

Please visit https://cpm.flvc.org for a current list of state-approved common prerequisites.

Required Courses

Common Prerequisites

MAC 2311	Calculus I
MAC 2312	Calculus II

MAC 2313	Calculus III	
MAP 2302	Differential Equations	
COP 2210	Introduction to Programming	
	or	
COP 2250	Java Programming	

Completion of one of the following courses with labs:

BSC 2010	General Biology I
BSC 2010L	General Biology Lab I
BSC 2011	General Biology II
BSC 2011L	General Biology Lab II
CHM 1045	General Chemistry I
CHM 1045L	General Chemistry Lab I
CHM 1046	General Chemistry II
CHM 1046L	General Chemistry Lab II
PHY 2048	Physics with Calculus I
PHY 2048L	Physics with Calculus Lab I
PHY 2049	Physics with Calculus II
PHY 2049L	Physics with Calculus Lab II

Students must choose one of the following majors:

Major in Mathematics – Comprehensive Track

The major in Mathematics – Comprehensive Track is the traditional Bachelor's degree in mathematics offers students the possibility of learning rigorously and deeply the fundamental ideas and concepts of modern mathematics. This track is mainly designed for students intending to pursue graduate studies in mathematics or graduate schools leading to careers in academia or engineering. Graduates can also enter the work force in fields where analytical skills are needed such as jobs in statistics, actuarial sciences, finance, biotech, and mathematics education.

Courses required for the degree:
Completion of one additional science course with lab from previous list, and

Required Courses

MAD 2104	Discrete Mathematics	3
MAS 3105	Linear Algebra	3
MAA 3200	Introduction to Advanced Mathematics	3
MAA 4211	Advanced Calculus	3
MAS 4301	Algebraic Structures	3
STA 4321	Mathematical Statistics I	3
MAT 4934	Senior Seminar	1
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

In addition, three courses from each of the following lists.

List 1

MAD 4203	Introduction to Combinatorics	3
MAA 4402	Complex Variables	3
MTG 3212	College Geometry	3
MAS 4203	Number Theory	3
MAA 4212	Topics in Advanced Calculus	3
MAS 4302	Topics in Algebraic Structures	3
MTG 4302	Topology	3

List 2

MAP 4401	Advanced Differential Equations	3
MAD 3301	Graph Theory	3
MAP 3103	Mathematical Modeling	3
STA 4322	Mathematical Statistics II	3
MAD 3401	Numerical Analysis	3
MHF 4302	Mathematical Logic	3
MHF 4102	Axiomatic Set Theory	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Mathematics – Applied Math Track

The major in Mathematics – Applied Math Track compared with the Comprehensive Track, less foundational and more application oriented. This track will prepare students for graduate studies in applied mathematics or engineering. Graduates can also enter the work force in fields where analytical skills are needed such as jobs in statistics, actuarial sciences, finance, biotech, mathematics education.

Required Courses

MAS 3105	Linear Algebra	3
MAD 2104	Discrete Mathematics	3
MAA 3200	Introduction to Advanced Mathematics	3
STA 4321	Mathematical Statistics I	3
MAA 4211	Advanced Calculus	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

Note: Students wishing to go to graduate school in Mathematical Sciences are strongly advised to take MAA 4402 Complex Variables.

Math Elective List

Four courses from the following list:

MAD 4203	Introduction to Combinatorics	3
MAA 4402	Complex Variables	3
MAA 4212	Topics in Advanced Calculus	3
MAS 4301	Algebraic Structures	3
MAS 4302	Topics in Algebraic Structures	3
MAP 4401	Advanced Differential Equations	3
MAD 3301	Graph Theory	3
STA 4322	Mathematical Statistics II	3
MAD 3512	Theory of Algorithms	3
MHF 4102	Axiomatic Set Theory	3
MHF 4302	Mathematical Logic	3
MAP 4634	Quantitative Risk Management	3
MAS 4203	Number Theory	3
MAP 4215	Stochastic Differential Equations	3
MAP 4315	Nonlinear Dynamics with Applications to	

	Sciences	3
MAP 3253	Mathematical Scientific Computation	3
MAP 4412	Introduction to Fourier Analysis	3
MAA 4504	Functional Analysis	3
MAS 4310	Introduction to Algebraic Geometry	3
MTG 4254	Differential Geometry	3
MTG 4302	Topology	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Mathematics – Biology Track

The major in Mathematics – Biology Track gives an opportunity to undergraduate mathematics students interested in biology to be exposed to the interplay between the two disciplines. It also provides a firm mathematical foundation necessary for graduate studies in the life sciences. Courses for this track includes mathematics, statistics, and biology.

Required Courses

MAS 3105	Linear Algebra	3
MAD 2104	Discrete Mathematics	3
MAA 3200	Introduction to Advanced Mathematics	3
STA 4321	Mathematical Statistics I	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAP 4401	Advanced Differential Equations	3
MAP 4315	Nonlinear Dynamics with Applications to Sciences	3
BSC 2010	General Biology I	3
BSC 2010L	General Biology Lab I	1
BSC 2011	General Biology II	3
BSC 2011L	General Biology Lab II	1
PCB 3063	Genetics	3

One upper division (level 3000 or higher) biology course with the approval of the math advisor

One course from the following list:

IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

One of the following two options

Option 1

STA 3163	Statistical Methods I	3
STA 3164	Statistical Methods II	3

Option 2: Two course among the following

STA 4234	Introduction to Regression Analysis	3
STA 4202	Introduction to Design of Experiments	3
STA 4502	Introduction to Non-parametric Methods	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Mathematics – Business Track

The major in Mathematics – Business Track gives an opportunity to undergraduate mathematics students interested in business and finance to be exposed to the interplay between mathematics and these two disciplines. It also provides a firm mathematical foundation necessary for graduate studies in finance. Courses needed for this track includes mathematics, statistics, economics, and business.

Required for the degree

ECO 2023	Principles of Microeconomics	3
ECO 2013	Principles of Macroeconomics	3

Upper Division Courses

MAS 3105	Linear Algebra	3
MAA 3200	Introduction to Advanced Mathematics	3
STA 4321	Mathematical Statistics I	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAP 4634	Quantitative Risk Management	3
MAP 4215	Stochastic Differential Equations	3
STA 4322	Introduction to Mathematical Statistics II	3
ACG 3024	Introduction to Accounting for Managers and Investors	3
FIN 3005	Introduction to Business Finance	3

One course from the following list:

IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

One course from the following list:

ECO 3101	Intermediate Microeconomics	3
ECO 3202	Applied Macroeconomics	3
ECO 3203	Intermediate Macroeconomics	3
ECO 3223	Money and Banking	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Mathematics – Chemistry Track

The major in Mathematics – Chemistry Track gives an opportunity to undergraduate mathematics students interested in chemistry to be exposed to the interplay between two disciplines. It also provides a firm mathematical foundation necessary for graduate studies in chemistry and the life sciences. Courses needed for this track include offerings from mathematics, statistics, and chemistry.

Required Courses

MAA 3200	Introduction to Advanced Mathematics	3
MAD 2104	Discrete Mathematics	3
STA 4321	Mathematical Statistics I	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAP 4401	Advanced Differential Equations	3
PHY 2048	Physics with Calculus I	4
PHY 2048L	General Physics Laboratory I	1
PHY 2049	Physics with Calculus II	4
PHY 2049L	General Physics Laboratory II	1
CHM 1045	General Chemistry I	3
CHM 1045L	General Chemistry Lab I	1
CHM 1046	General Chemistry II	3
CHM 1046L	General Chemistry Lab II	1
CHM 2210	Organic Chemistry I	4
CHM 3410	Physical Chemistry I	4
CHM 3411	Physical Chemistry II	4
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

And one course from the following list:

MAP 3253	Mathematical Scientific Computation	3
MAA 4402	Complex Variables	3
STA 4322	Introduction to Mathematical Statistics II	3

Note: Students wishing to pursue a graduate degree in Mathematical Sciences are strongly advised to take MAA 4211 and MAS 4301. Students wishing to pursue graduate studies in Biochemistry or Bioinformatics will be encouraged to take Biological Chemistry CHM 4304 (the Chemistry Department will waive Organic Chemistry II CHM 2211 and Quantitative Analysis CHM 3120).

Major in Mathematics – Computer Science Track

The major in Mathematics – Computer Science Track gives an opportunity to undergraduate mathematics students interested in computer science to be exposed to the interplay between the two disciplines. It also provides a firm mathematical foundation necessary for graduate studies in computer science. Courses needed for this track include offerings from mathematics, statistics, and programming.

Required Courses

MAA 3200	Introduction to Advanced Mathematics	3
MAD 2104	Discrete Mathematics	3
MAS 3105	Linear Algebra	3
STA 4321	Mathematical Statistics I	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAD 3512	Theory of Algorithms	3
COP 3337	Computer Programming II	3
COP 3530	Data Structures	3
CDA 3103	Fundamentals of Computer Systems	3
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

And one course from the following list:

MAP 3253	Mathematical Scientific Computation	3
MAA 4402	Complex Variables	3
STA 4322	Introduction to Mathematical Statistics II	3

And one course from the following list:

COP 4338	Systems Programming	3
COP 4710	Database Management	3
CAP 4770	Introduction to Data Mining	3
COP 4534	Algorithm Techniques	3
CAP 4710	Principles of Computer Graphics	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor.

Major in Mathematics – Economics Track

The major in Mathematics – Economics Track gives an opportunity to undergraduate mathematics students interested in economics to be exposed to the interplay between two disciplines. It also provides a firm mathematical foundation necessary for graduate studies in economics or finance. Courses needed for this track includes mathematics, statistics, and economics.

Required Courses

MAS 3105	Linear Algebra	3
MAD 2104	Discrete Mathematics	3
MAA 3200	Introduction to Advanced Mathematics	3
STA 4321	Mathematical Statistics I	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAA 4211	Advanced Calculus	3
MAP 4215	Stochastic Differential Equations	3
STA 4322	Introduction to Mathematical Statistics II	3
ECO 2023	Principles of Microeconomics	3
ECO 2013	Principles of Macroeconomics	3
ECO 3101	Intermediate Microeconomics	3
ECO 3203	Intermediate Macroeconomics	3
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

And one course from the following list:

ECO 4400	Economics of Strategy and Information	3
ECO 4421	Introduction to Econometrics	3
ECO 4933	Topics in Theory	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Mathematics – Physics Track

The major in Mathematics – Physics Track gives an opportunity for undergraduate mathematics students interested in physics to be exposed to the interplay between the two disciplines. It also provides a firm mathematical foundation needed for graduate studies in the physical sciences. Courses needed for this track include offerings from mathematics, statistics, and physics.

Required Courses

MAS 3105	Linear Algebra	3
MAA 3200	Introduction to Advanced Mathematics	3
MAD 3401	Numerical Analysis	3
MAP 4104C	Topics in Mathematical Modeling	4
MAP 4401	Advanced Differential Equations	3
STA 4321	Introduction to Mathematical Statistics I	3
PHY 3106	Modern Physics	3
PHY 3802L	Intermediate Physics Lab	3
One course from the following list:		
IDS 4174	Mathematics and Philosophy in Arts	3
MHF 3404	History of Mathematics	3
MHF 4401	Methods in the History of Modern Mathematics	3

Any two of the following course sequences:

PHY 4221 &	Introduction to Classical Mechanics	4
PHY 4222	Advanced Classical Mechanics	3
	or	
PHY 4323 &	Intermediate Electromagnetism I	3
PHY 4324	Intermediate Electromagnetism II	3
	or	
PHY 4604 &	Quantum Mechanics I	3
PHY 4605	Quantum Mechanics II	3

Any two courses from the following list:

MAA 4211	Advanced Calculus	3
MAA 4402	Complex Variables	3
MAA 4504	Functional Analysis	3
MAP 4215	Stochastic Differential Equations	3
MAP 4315	Nonlinear Dynamics with Applications to Sciences	3
MAP 4412	Introduction to Fourier Analysis	3
MAS 4301	Algebraic Structures	3
MTG 4254	Differential Geometry	3
STA 4322	Introduction to Mathematical Statistics II	3

Electives

The balance of the 60 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks*: The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a Mathematics major: MAC 2233, STA 1013, STA 2122, STA 3123, STA 2023, and QMB 3200 (College of Business).

Major in Statistics

The Statistics major is designed to teach students how to collect, analyze, and interpret data. Graduating students will have the necessary job skills for employment in a variety of fields. However, the courses are rigorous so that students are well prepared to pursue a graduate degree in statistics.

Upper Division Program

Required Courses: (37)

MAS 3105	Linear Algebra	3
STA 3163	Statistical Methods I	3
STA 3164	Statistical Methods II	3
STA 3951	Oral Presentations in Statistics – *GL*	1
STA 4321	Introduction to Mathematical Statistics I	3
STA 4322	Introduction to Mathematical Statistics II	3
STA 4202	Introduction to Design of Experiments	3
STA 4234	Introduction to Regression Analysis	3
STA 4664	Statistical Quality Control	3
ENC 3213	Professional & Technical Writing	3

Six additional credit hours of approved statistics courses. Three additional credit hours in an approved statistics, mathematics, or computer science course. A grade of 'C' or higher in each of these courses is necessary for the major.

Electives

The balance of the 120 semester hour requirement for graduation may be chosen from any courses in the University approved by the student's advisor. *Remarks:* The student must consult his or her advisor to determine which courses, in addition to the required courses listed above, satisfy the requirements for a statistics major. The following courses are not acceptable for credit toward graduation, unless a student has passed the course before declaring a statistics major: MAC 2233, STA 1013, STA 2023, STA 3033, STA 3111, STA 3112, STA 2122, STA 3123, STA 3145 and QMB 3200 (College of Business).

Combined BS/MS in Mathematical Sciences Degree Pathway

This pathway will allow strong students in mathematics to complete a bachelor's degree and a master's degree in 5 years rather than the usual six. A minimum of 140 credits are required for graduation with both the bachelor's and the master's degree. In addition to fulfilling the requirements for the Bachelor's degree in mathematics, these 140 credits include 30 graduate credits required for the Masters of Science in Mathematical Sciences. A maximum of ten (10) graduate mathematics credits can be concurrently used toward the bachelor's and master's degrees.

To be considered for admission to the combined bachelor's/master's degree pathway, students must have completed at least 75 credits in the bachelor's degree program at FIU and meet the admissions criteria for the graduate degree program to which they are applying. Students need only apply once to the combined degree pathway, but the application must be submitted to Graduate Admissions before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships. Only 5000-level or higher courses, and no more than the number of credits specified by the program catalog, may be applied toward both degrees.

Admission Requirements

1. Current enrollment in a Bachelor's degree program in mathematics.
2. Current overall GPA of at least 3.2 and GPA of at least 3.2 in upper division courses.
3. Completion of 75-90 undergraduate credit-hours.
4. (Verbal and Quantitative) GRE scores with a minimum of 151 in the quantitative portion before entering the MS phase of the program.
5. Approval of the graduate committee.

Completion Requirements

Year 1 and 2:

MAC 2311	Calculus I
MAC 2312	Calculus II
MAC 2313	Calculus III
MAS 3105	Linear Algebra
MAP 2302	Ordinary Differential Equations

Year 3
Fall

MAA 3200	Introduction to Advanced Mathematics
STA 4321	Introduction to Mathematical Sciences I

Spring

MAA 4211	Advanced Calculus
MAS 4301	Algebraic Structures

One course from List 1 or 2

Summer
One course from List 1 or 2 and 1 graduate course

Year 4
Fall

MAA 6616	Real Analysis

One course from List 1 or 2
Senior Seminar (1 credit)

Spring
One graduate course
Two courses from List 1 or 2

Summer
Three graduate credits

Year 5
Fall
Nine graduate credits

Spring
Nine graduate credits

The graduate courses distribution should follow catalog descriptions of the master's program requirements. Students must take at least 3 courses from List 1 and at least 3 courses from List 2. The balance of the 140 semester hours required for graduation may be chosen from any courses in the university, a minimum of six (6) of these should be at the upper division level or higher.

List 1

MAD 4203	Introduction to Combinatorics	3
MAA 4402	Complex Variables	3
MTG 3212	College Geometry	3
MAS 4203	Number Theory	3
MAA 4212	Topics in Advanced Calculus	3
MAS 4302	Topics in Algebraic Structures	3
MTG 4302	Topology	3

List 2

MAP 4401	Advanced Differential Equations	3
MAD 3301	Graph Theory	3
MAP 3103	Mathematical Modeling	3
STA 4322	Mathematical Statistics II	3
MAD 3401	Numerical Analysis	3
MHF 4302	Mathematical Logic	3
MHF 4102	Axiomatic Set Theory	3

Bachelor of Arts in Mathematics: Mathematics Education Major (FIUteach)

Degree Program Hours: 120

Lower Division Preparation

To qualify for admission to the program, a student must have met all the lower division requirements and must be otherwise acceptable into the program. In addition to the University Core Curriculum, Foreign Language, and Common Prerequisites, requirements include a minimum overall GPA of 2.5 for all lower-division/transfer coursework and achieve the competencies of the FTCE General Knowledge Exam.
All students must pass the GK Exam by the time they reach 72 credit hours in their program of study. All stated admission requirements are to be considered minimum.
A student who meets these minimum requirements is not automatically assured admission. Program admission requirements are subject to change. It is the responsibility of the student to assure that he/she has met the requirements.

Common Prerequisite Courses and Equivalencies

FIU Course(s)	Equivalent Course(s)
MAC 2311	MACX311
MAC 2312	MACX312
MAC 2313	MACX313
MAP 2302	MAPX302
COP 2250 or COP 2210 or COP 2270	COPXXXX[1]
BSC 2010, BSC 2010L, BSC 2011, BSC 2011L,	BSCXXXX/XXXXL[2] or
CHM 1045, CHM 1045L, CHM 1046, CHM 1046L,	CHMXXXX/XXXXL[2] or
PHY 2048, PHY 2048L, PHY 2049, PHY 2049L	PHYXXXX/XXXXL[2]

[1]a scientific programming course designed for computer science majors.
[2]one laboratory based science course designed for science majors.

Courses which form part of the statewide articulation between the State University System and the Florida College System will fulfill the Lower Division Common Prerequisites.
Please visit https://cpm.flvc.org for a current list of state-approved common prerequisites.

Common Prerequisites

MAC 2311	Calculus I
MAC 2312	Calculus II
MAC 2313	Calculus III

MAP 2302	Differential Equations
COP 2250	Java Programming
	or
COP 2210	Introduction to Programming
	or
COP 2270	Secure C Programming For Engineers

Completion of one of the following courses with labs:

BSC 2010	General Biology I
BSC 2010L	General Biology Lab I
BSC 2011	General Biology II
BSC 2011L	General Biology Lab II
CHM 1045	General Chemistry I
CHM 1045L	General Chemistry Lab I
CHM 1046	General Chemistry II
CHM 1046L	General Chemistry Lab II
PHY 2048	Physics with Calculus I
PHY 2048L	Physics with Calculus Lab I
PHY 2049	Physics with Calculus II
PHY 2049L	Physics with Calculus Lab II

Courses required for the degree:

SMT 2661	Step 1: Inquiry Approaches to Teaching Mathematics and Science	1
SMT 2662	Step 2: Inquiry-Based Lesson Design in Mathematics and Science	1
	or	
SMT 2044	Combined STEP 1 & 2: Inquiry-Based Approaches and Lesson Design for Teaching Mathematics and Science	2

Completion of one additional science course with lab from previous list, and

MAD 2104	Discrete Math
MAS 3105	Linear Algebra

Upper Division Math and Statistics Core: 25

MAT 3501	Numbers, Functions and Modeling for Teachers	3
MAA 3200	Introduction to Advanced Mathematics	3
MTG 3212	College Geometry	3
MHF 3404	History of Mathematics – *GL*	3
MAS 4203	Number Theory	3
MAT 4510	Problem Solving Seminar	3
STA 4321	Introduction to Mathematical Statistics I	3
	or	
STA 3163	Statistical Methods I	3
MAP 4104C	Topics in Mathematical Modeling	4

Upper Division Education Core: 27

SMT 3100	Knowing and Learning in Mathematics and Science	3
MAE 4394	Perspectives in Math and Science Education – *GL*	3
RED 4325	Subject Area Reading	3
SMT 4301	Classroom Interactions in Mathematics and Science Teaching	3
TSL 4324	ESOL Issues and Strategies for Content Area Teachers – *GL*	3
SMT 4664	Problem-Based Instruction (PBI) in Mathematics and Science	3
MAE 4942	Student Teaching	9

Minor in Mathematics

Required Courses

MAC 2311-2-3 Calculus I-I-III *(or equivalent)*.

Plus four math courses from those approved for the upper division program of the BS in Mathematics. MAP 2302 and MAS 3105 may be included among these four courses.

A grade of 'C' or higher is necessary for the minor. *Remarks:* Courses completed elsewhere may be applied to the Mathematics minor, with the approval of the department. However, at least 2 of the 4 courses noted above, excluding MAC 2311-2-3, must be completed at FIU.

Minor in Mathematical Sciences

Required Courses

MAC 2311-2-3. Calculus I,II,III (or equivalent).
Plus MAP 2302, MAS 3105, and two courses from the following list:

COP 3337	Intermediate Programming	3
CDA 3402	Fundamentals of Computer Systems	3
MAD 2104	Discrete Mathematics	3
MAD 3401	Numerical Analysis	3
MAD 3512	Theory of Algorithms	3
MAT 4934	Senior Seminar	1
MAP 4401	Advanced Differential Equations	3
STA 3163-4	Statistical Methods I and II	3-3
COP 3530	Data Structures	3
MAA 4402	Complex Variables	3
MAD 3301	Graph Theory	3
MAD 4203	Introduction to Combinatorics	3
MAD 5405	Numerical Methods	3
MAP 3103	Mathematical Modeling	3
MAS 5145	Applied Linear Algebra	3
MHF 4302	Mathematical Logic	3
STA 4603	Mathematical Techniques in Operations Research I	3
STA 4604	Mathematical Techniques in Operations Research II	3
STA 5446	Probability Theory I	3

A grade of 'C' or higher is necessary for the minor. *Remarks*: Courses completed elsewhere may be applied to the Mathematical Sciences minor, with the approval of the department. However, at least 2 of the 4 courses noted above, excluding MAC 2311-2-3, must be completed at FIU.

Minor in Statistics

Lower or Upper Division Preparation: (3 or 4)

MAC 2312	Calculus II	4
	or	
STA 2023	Statistics for Business and Economics	3
	or	
STA 2122	Statistics for Behavioral and Social Sciences I	3
	or	
STA 3111	Statistics I	3

Upper Division Program: (12)

Required Courses

STA 3163	Statistical Methods I	3
STA 3164	Statistical Methods II	3

Two additional courses from the following list:

STA 3033	Introduction to Probability and Statistics for CS	3
	or	
STA 4321	Introduction to Mathematical Statistics I[1]	3
STA 4322	Introduction to Mathematical Statistics II	3
STA 4202	Introduction to Design of Experiments	3
STA 4234	Introduction to Regression Analysis	3
STA 4502	Introduction to Nonparametric Methods	3
STA 4664	Statistical Quality Control	3

[1]STA 4321 has MAC 2313 as a prerequisite.

A grade of 'C' or higher in each of these courses is necessary for the minor.

Remarks: No courses in statistics, mathematics or computer sciences can be applied to more than one minor in these disciplines, nor can courses used to satisfy major requirements be used towards minor requirements. In the case where a course is required for both a major in one area and a minor in another, the student should see his or her advisor for an appropriate substitution for the requirement of the minor.

Certificate Program in Actuarial Studies

The department offers a certificate in Actuarial Studies. For further information refer to the Certificate section at the end of the College of Arts, Sciences and Educations' section. For detailed information see section about certificate programs in the university catalog.

Course Descriptions

Definition of Prefixes

COT-Computing Theory; IDS-Interdisciplinary Studies; MAA-Mathematics: Analysis; MAC-Mathematics: Calculus and Pre-Calculus; MAD-Mathematics: Discrete; MAE-Mathematics Education; MAP-Mathematics Applied; MAS-Mathematics: Algebraic Structures; MAT-Mathematics; MGF-Mathematics: General and Finite; MHF-Mathematics: History and Foundations; MTG-Mathematics: Topology and Geometry; STA-Statistics

F-Fall semester offering; S-Spring semester offering; SS-Summer semester offering.

Courses that meet the University's Global Learning requirement are identified as GL.

COT 5310 Theory of Computation I (3). Abstract models of computation; halting problem; decidability and undecidability; recursive function theory. Prerequisite: MAD 3512.

IDS 4174 Mathematics and Philosophy in Arts – *GL* (3). A panorama and a study of the global interrelation of mathematics, philosophy, and visual arts with emphasis on the evolution of the role of geometry in depicting the perspective in arts.

MAA 3200 Introduction to Advanced Mathematics (3). Topics include: naive set theory, functions, cardinality, sequences of real numbers and limits. Emphasis on formal proofs. Prerequisite: MAD 2104 and MAC 2312. (F)

MAA 4211 Advanced Calculus (3). An intense study of the foundations of calculus. Topics may include: the real number system, continuity, differentiation, Riemann-Stieltjes integration, and series of functions. Note: The student must complete MAA 3200 before attempting this course. Prerequisites: MAC 2313, MAS 3105 and MAA 3200. (S)

MAA 4212 Advanced Calculus II (3). A sequel to MAA 4211. Topics may include: theory of integration; analysis in several variables; and Fourier series. Prerequisite: MAA 4211.

MAA 4402 Complex Variables (3). An introduction to complex variables, beginning with the algebra and geometry of the complex number system. Topics include: complex functions; analytic functions; Cauchy's theorem and its consequences; Taylor and Laurent series; residue calculus; evaluation of real integrals and summation of series; conformal mapping. Prerequisites: MAC 2313, and MAP 2302 or MAA 4211. (F)

MAA 4504 Functional Analysis (3). Metric spaces, Banach spaces, L^p spaces, Hahn Banach theorem, Hilbert spaces, contractions, fixed point theorems and applications to differential equations and numerical analysis. Prerequisites: MAC 2313, MAS 3105.

MAC 1000 College Algebra Stretch (0). Develops deeper problem-solving and algebraic skills of college algebra. Students can repeat this course. Prerequisite: Consent of the department.

MAC 1105 College Algebra (3). Operations on polynomials, rational expressions, radicals; curves, lines, circles; functions, inverse functions, exponential and logarithmic functions; systems of equations and inequalities. (F,S,SS)

MAC 1114 Trigonometry (3). Trigonometric functions, identities, conditional equations, polar coordinates, vectors, polar graphs, complex numbers, De Moivre's Theorem, conic sections. Student cannot receive credit for both this course and MAC 1147 Pre-Calculus. Prerequisites: MAC 1105 or appropriate score on placement exam for students with no prior college-level coursework in mathematics. (F,S,SS)

MAC 1140 PreCalculus Algebra (3). Covers polynomial, rational, exponential and logarithmic functions: zeros of polynomials; conic sections; determinant and Cramer's rule; sequences and series; induction; binomial theorem. Students cannot receive credits for both this course and MAC 1147. Prerequisites: MAC 1105 or appropriate score on placement exam for students with no prior college-level coursework in mathematics.

MAC 1147 Pre-Calculus Algebra and Trigonometry (4). Polynomials, Rational, Exponential and Logarithmic Functions, Trigonometry, Conic Sections, Cramer's Rule, Sequences and Series, Induction, Binomial theorem. Student cannot receive credit for both this course and MAC 1140 and/or MAC 1114. Prerequisites: Grade of "C" or higher in MAC 1105 or appropriate score on placement exam for students with no prior college-level coursework in mathematics. (F,S,SS)

MAC 1907 Pre-Calculus Algebra and Trigonometry Stretch (0). Version of MAC 1147 for continuing students with an unfinished grade. Develops deeper problem solving skills of the concepts of precalculus. Course can be repeated. Prerequisite: Consent of the Department

MAC 2005 Calculus II Stretch (0). This will be a section of Calculus 2 for students with an unfinished grade. It helps students learn techniques and applications of integration and infinite series, and apply them to their major. Prerequisite: Consent of the department.

MAC 2233 Calculus For Business (3). Basic notions of differential and integral calculus using business applications and models including: differential and integral calculus using polynomials, exponential and logarithmic functions. Prerequisites: Grade of "C" or higher in MAC 1105 or appropriate score on placement exam for students with no prior college-level coursework in mathematics. (F,S,SS)

MAC 2241 Calculus 1 for Biology (4). Emphasis on applications to biological systems. Concepts of calculus will be developed together with solutions, techniques of both analytical and numerical nature. Prerequisite: MAC 1147 or (MAC 1114 and MAC 1140).

MAC 2241L Lab for Calculus 1 for Biology (1). Review of numerical methods used in calculus 1 by students in QBIC program. Prerequisite: Permission of the department.

MAC 2242 Calculus 2 for Biology (4). A continuation of Calculus 1 for Biology. Covers calculus 2 concepts with emphasis on biological applications. A portion of the course deals with differential equations. Prerequisite: MAC 2241.

MAC 2242L Lab for Calculus 2 for Biology (1). Review of numerical methods in calculus 2 by students in QBIC program. Prerequisite: Permission of the department.

MAC 2281 Calculus I for Engineering (4). Limits, techniques of differentiation, graphs, optimization, applications relevant in engineering settings. Prerequisite: Grade of "C" or better in MAC 1147 or both courses MAC 1140 and MAC 1114 or appropriate score on placement exams

MAC 2282 Calculus II for Engineering (4). Fundamental Theorem of calculus, techniques of integration, volumes, surface area, convergence of series, Taylor series, polar coordinates, applications relevant in engineering. Prerequisite: Grade of "C" or better in Calculus 1 (MAC 2281 or MAC 2311).

MAC 2283 Calculus III for Engineering (4). Vector valued functions, rectangular, cylindrical, spherical coordinates, differential and integral calculus for functions of several variables. Green, Divergence, and Stokes Theorems. Prerequisites: Prerequisites: Grade of "C" or better in Calculus 2 (MAC2282 or MAC2312) or equivalent

MAC 2311 Calculus I (4). Limits, derivatives and their formulas, applications of derivatives, introduction to anti derivatives, introduction to parametric curves. Prerequisites: Grade of "C" or higher in MAC 1147 or MAC 1140 and MAC 1114 or appropriate score on placement exam for students with no prior college-level coursework in mathematics. (F,S,SS)

MAC 2312 Calculus II (4). Applications of the integral, integration techniques, improper integrals, Riemann sums, the integral, Fundamental Theorem of Calculus, infinite series, Taylor series, polar coordinates, parametric equations. Prerequisites: Grade of "C" or higher in MAC 2311 or AP Calculus credit. (F,S,SS)

MAC 2313 Multivariable Calculus (4). This course deals with the differential and integral calculus of real valued multivariable functions. The topics include: directional and partial derivatives, gradients, and their applications; differential calculus of vector valued functions; multiple, iterated, line, and surface integrals. Prerequisites: MAC 2312 or equivalent with a grade of 'C' or better. (F,S,SS)

MAD 1100 Mathematics for Information Technology (3). Introduction to discrete mathematical structures with emphasis on applications to information technology: binary numbers, logic, sets, functions, recursion, combinatorics, graph theory, Boolean algebra. Prerequisites: MAC 1105 or MGF 1106 or appropriate score on placement exam for students with no prior college-level coursework in mathematics.

MAD 2104 Discrete Mathematics (3). Sets, functions, relations, permutations, and combinations, propositional logic, matrix algebra, graphs and trees, Boolean algebra, switching circuits. Prerequisites: MAC 1105 or MGF 1106 or appropriate score on placement exam for students with no prior college-level coursework in mathematics. (F,S,SS)

MAD 3301 Graph Theory (3). An introduction to the study of graphs. Topics include the following: paths and circuits, connectedness, trees, shortest paths, networks, planar graphs, the coloring of graphs, and directed graphs. Applications of graphs to computer science will be discussed. Prerequisites: COP 2210, COP 2250, or COP 2270 or CGS 2420 and either MAS 3105 or MAD 2104. (F,S,SS)

MAD 3401 Numerical Analysis (3). Basic ideas and techniques of numerical analysis. Topics include: finite differences, interpolation, solution of equations, numerical integration and differentiation, applications, introduction to applied linear algebra. This course will make extensive laboratory use of the computer facility. Prerequisites: COP 2210, COP 2250, COP 2270, or CGS 2420 and MAC 2312. (F,S,SS)

MAD 3512 Theory of Algorithms (3). Strings, formal languages, finite state machines, Turing machines, primitive recursive and recursive functions, recursive unsolvability. Prerequisite: MAD 2104. Computer Science majors must also take COT 3541. (F,S,SS)

MAD 4203 Introduction to Combinatorics (3). A survey of the basic techniques of combinatorial mathematics. Topics will include the Pigeonhole Principle, Binomial Coefficients, Inclusion-Exclusion, Recurrence Relations, and Generating Functions. Prerequisites: MAC 2312 and MAD 2104.

MAD 5405 Numerical Methods (3). Advanced ideas and techniques of numerical analysis for digital computation. Topics include: linear and non-linear systems, ordinary differential equations, continuous system modeling techniques, and languages. Prerequisites: MAS 3105 and MAP 2302.

MAE 3893 Mathematics Education Seminar (1). Provides students committed to Mathematics Education an early teaching experience and it will provide other

students a low pressure opportunity to try out teaching. Prerequisite: MAC 2311.

MAE 3894 Early Teaching Experience (1). The goal of this course is to provide early in the program a unique opportunity for math education students to experience the tastes, the challenges, and the rewards involved in the teaching of math. Prerequisite: MAC 2311.

MAP 2302 Differential Equations (3). An introduction to differential equations and their applications, based upon a knowledge of calculus. Topics to include: initial value problems of the first order, numerical solutions, systems of differential equations, linear differential equations, Laplace transforms, series solutions. Prerequisite: MAC 2312 with a grade of 'C' or better. (F,S,SS)

MAP 3103 Mathematical Modeling and Applications (3). A course to provide an understanding of the use of mathematical models in the description of the real world. Basic principles in the philosophy of formal model building as well as specific models will be considered. Prerequisites: MAS 3105 and either MAC 2313 or MAP 2302.

MAP 3103L Lab for Mathematical Modeling (1). Lab sessions complement the course of mathematical modeling (MAP 3103). Computer projects using "MATLAB" will be used. Prerequisite: MAS 3015 and (MAP 2302 or MAC 2313). Corequisite: MAP 3103.

MAP 3253 Mathematical Scientific Computation (3). To acquaint students with some mathematical programming skills involving numerical computation software like Mathematics, Matlab, scientific document processing LaTeX, and data analysis tool Excel. Prerequisites: MAC 2312, MAS 3105.

MAP 4104C Topics in Mathematical Modeling (4). Introductory survey of applied mathematics with emphasis on modeling of physics and biological problems in terms of differential equations. Prerequisites: MAP 2302, and MAC 2313, and MAS 3105.

MAP 4215 Stochastic Differential Equations (3). Introduces the fundamental theories and important applications of stochastic differential equations. Topics include stochastic calculus, stochastic differential equations and applications. Prerequisites: MAP 2302, MAC 2313, MAS 3105, STA 4321.

MAP 4315 Nonlinear Dynamics with Applications to Sciences (3). The use of mathematics in order to solve real-world problems in all areas of science. Among other topics, the course will also give a first introduction into the chaos theory. Prerequisites: MAC 2313 and/or MAP 2302 and/or MAS 3105, or permission of the instructor.

MAP 4401 Advanced Differential Equations (3). A second course in differential equations. Topics may include: Bessel functions and other special functions arising from classical differential equations, Sturm-Liouville problems, partial differential equations, transform techniques. Prerequisites: MAP 2302 and MAC 2313. (S)

MAP 4401L Lab for Advanced Differential Equations (1). Lab sessions complement the course of advanced differential equations (MAP 4401). Computer projects using "MATLAB" will be used. Prerequisites: MAP 2302, MAC 2313. Corequisite: MAP 4401.

MAP 4412 Introduction to Fourier Analysis (3). Abstract measure theory, L^p spaces, Fourier transform in L^2, Plancherel theorem, Fourier transform of distributions, fundamental solutions of differential equations, application wavelets. Prerequisites: MAC 2313, MAS 3105.

MAP 4634 Quantitative Risk Management (3). Interdisciplinary course with a strong quantitative approach to the risk management process of small and big businesses. Prerequisites: MAC 2313, MAP 2302, MAS 3105.

MAP 5117 Mathematical and Statistical Modeling (3). Study of ecological, probabilistic, and various statistical models. Prerequisites: COP 2210, MAC 2313, MAS 3105; and STA 3033 or STA 3164 or STA 4322.

MAP 5204 Optimization and Linear Algebra (3). Vectors, Euclidean spaces, operations on matrices, rank, determinants, linear and quadratic programming, Kuhn, Tucker techniques for constrained optimization. Prerequisite: MAC 2313.

MAP 5208 Numerical Optimization (3). The generalization of optimization theory and techniques to other formulations comprise a large area of applied mathematics. This course is mainly about convex optimizations. Prerequisites: MAP 2302, MAC 2313, MAS 3105.

MAP 5236 Mathematical Techniques of Operations Research (3). This course surveys the mathematical methods used in operations research. Topics will be chosen from linear programming, dynamic programming, integer programming, network analysis, classical optimization techniques, and applications such as inventory theory. Prerequisites: MAP 5117 and MAS 3105 and COP 2210.

MAP 5255 Mathematical Scientific Computation (3). Programming in Matlab, Graphics in Matlab, Creating GUIs in Matlab, Simulink. Prerequisites: MAC 2313, MAP 2302, MAS 3105.

MAP 5316 Ordinary Differential Equations (3). Existence and uniqueness theorem, matrix formulation, physical applications, regular singular points, autonomous systems, Laplace transform, special topics. Prerequisites: MAA 3200, MAA 4402 and MAS 3105.

MAP 5317 Advanced Differential Equations for Engineers (3). Topics may include Bessel Functions and other special functions arising from classical differential equations, Sturm-Liouville problems, partial differential equations, transform techniques. Credit may not be counted for both MAP 4401 and MAP 5317. Credit for MAP 5317 may not be applied toward the Master's degree in Mathematical Sciences. Prerequisites: MAC 2313 and MAP 2302.

MAP 5318 Dynamical Systems and Introduction to Chaos Theory (3). Important techniques for linear systems of differential equations and nonlinear systems, as well as applications of these systems in a wide variety of fields. Prerequisites: MAS 3105, or equivalent, or permission of the instructor.

MAP 5407 Methods of Applied Analysis (3). Convergence, fixed point theorems, application to finding roots of equations, normed function spaces, linear operators, applications to numerical integration, differential and integral equations. Prerequisites: MAA 4211, MAP 2302, and MAS 3105.

MAP 5415 Introduction to Fourier Analysis (3). Basic real analysis, and measure theory, L^p spaces and convolution, the Fourier transform in L^2, Plancherel theorem, application to differential equations and wavelets. Prerequisites: Advanced Calculus, Linear Algebra.

MAP 5467 Stochastic Differential Equations and Applications (3). Review of measure theory, stochastic processes, Ito Integral and its properties, martingales and their generalizations, stochastic differential equations, diffusions. Applications to boundary value problems and finance. Prerequisites: MAS 3105, MAP 4401, MAA 4211, MAA 5616 or permission of instructor.

MAS 3105 Linear Algebra (3). An introduction to the topics in linear algebra most often used in applications. Topics include: matrices and their applications; simultaneous linear equations and elementary operations; linear dependence; vector spaces; rank and inverses; inner products and 'best' approximations; numerical solutions of simultaneous linear equations; eigen-values and eigenvectors; iterative methods for calculating eigenvalues; and systems of linear equations. Prerequisite: MAC 2312. (F,S,SS)

MAS 3931 Topics in Actuarial Mathematics (1). Topics related to calculus/linear algebra such as mono-tone sequences, least upper bound, complex arithmetic, solid analytic geometry, linear transformations. Mathematics involved in insurance. Prerequisite: Admission to Actuarial Studies Certificate program.

MAS 4203 Number Theory (3). Topics to be discussed are selected from the following: congruencies, Diophantine equations, distribution of primes, primitive roots, quadratic reciprocity, and classical theorems of number theory. Prerequisites: MAA 3200, MAS 3105 or MTG 3212. (SS)

MAS 4301 Algebraic Structures (3). An introduction to abstract mathematical structures of modern algebra. Fundamental concepts of groups, rings, and fields will be studied. Note: the student must complete MAA 3200 before attempting this course. Prerequisites: MAS 3105 and MAA 3200. (S)

MAS 4302 Topics in Algebraic Structures (3). A sequel to Algebraic Structures. Topics may include: a continuation of the study of groups, rings and/or fields; polynomial domains; Euclidean domains; and Galois theory. Prerequisite: MAS 4301.

MAS 4310 Introduction to Algebraic Geometry (3). Introduction to the theory of affine and projective algebraic varieties over algebraically closed ground field. Various examples are discussed. Prerequisites: MAS 4301 and MAA 4402.

MAS 4316 Introduction to Commutative Algebra (3). Basic concepts, constructions and methods; emphasis on Noetherian, Artinian rings and modules; Primary Decompositions; Krull's dimension; Integral dependence; Dedekind domains. Prerequisite: MAS 4301

MAS 5145 Applied Linear Algebra (3). Vector spaces and linear maps, solutions of linear systems, orthogonal projection and QR factorization, determinant and eigenvalues of a matrix. Prerequisites: MAS 3105 and MAA 3200.

MAS 5311 Graduate Algebra (3). A study of the basic material on groups, rings and vector spaces. Topics include the Jordan-Holder theorem, structure of modules over Euclidean domains and canonical forms of matrices. Prerequisites: MAS 4301 or equivalent.

MAS 5312 Galois Theory (3). Extension fields, ruler and compass constructions, fundamental theorem of Galois Theory, cyclotomic and cyclic extensions, solutions of equations by radicals, selected topics. Prerequisites: MAS 5311 or permission of the instructor.

MAS 5315 Algebraic Geometry (3). Introduction to the theory of affine and projective schemes, coherent sheaves and sheaf cohomology. Application to studying algebraic varieties. Prerequisites: MAS 4301, MAA 4402.

MAT 1033 Intermediate Algebra (3). Serves as preparation for entry level mathematics courses. Topics include operations on algebraic expressions, solving equations and inequalities in one and two variables and graphing.

MAT 3501 Numbers, Functions and Modeling for Teachers (3). It is required for math majors in FIU teach program. Students will demonstrate proficiency in working with mathematical ideas and solving problems involving integers, real, and complex numbers. Prerequisites: MAD 2104 and MAC 2312.

MAT 3905 Independent Study (VAR). Individual conferences, assigned readings, and reports on independent investigations.

MAT 4510 Problem Solving Seminar (3). To strengthen students ability in solving basic mathematics problems by teaching them more advanced techniques for dealing with challenging problems. Prerequisites: MAC 2313, MAS 3105, MAA 3200, MTG 3212, and MAS 4203 or permission of the instructor.

MAT 4905 Independent Study (VAR). Individual conferences, assigned readings, and reports on independent investigations.

MAT 4930 Special Topics (VAR). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

MAT 4934 Senior Mathematics Seminar (1). An exploration of research topics in the student's subfield. Coursework will include a written report, oral presentation, and departmental major field test. Prerequisite: Senior standing.

MAT 4943 Mathematical Sciences Internship (VAR). A special program to encourage students to get on-the-job experience in computer sciences, statistics, or mathematics in an industrial enterprise, governmental agency or other organization. Requirements: minimum grade of 'B' or higher in all courses in the major area, and

approval by Departmental Internship Committee. Application is required at least one term in advance of registration for this course. Prerequisite: Departmental approval.

MAT 5907 Independent Study (VAR). Individual conferences, assigned reading, and reports on independent investigations.

MAT 5921 Training in Mathematical Exposition (0). Students prepare and present supervised lectures on undergraduate mathematical topics to fellow students.

MAT 5970 Master's Research (1-6). Research toward preparation of master's project. Prerequisite: Permission of graduate committee.

MGF 1000 Finite Mathematics Stretch (0). This will be a section for students in MGF 1106 with an unfinished grade. Helps students develop better understanding of topics such as probability and logic and apply it in their major. Prerequisite: Consent of the department.

MGF 1001 Social Choice Mathematics Stretch (0). This course will help students develop a deeper understanding on how mathematics is used in our social life and help them make better financial decisions. Prerequisite: Consent of the department.

MGF 1100 Exploration of Mathematics and Quantitative Reasoning (3). Designed to provide non-science students with meaningful and up-to-date introductory mathematical concepts. Critical thinking skills are enhanced through fundamental reasoning.

MGF 1106 Finite Mathematics (3). Study of concepts and applications involving finite mathematical processes such as sets, combinatorial techniques, formal logic, discrete probability, linear systems, matrices, linear programming. Prerequisite: Working knowledge of high school algebra. (F,S,SS)

MGF 1107 The Mathematics of Social Choice and Decision Making (3). Voting systems and their desirable properties. Weighted voting systems, fair division procedures, apportionment methods and game theory.

MHF 3404 History of Mathematics – *GL* (3). Development of mathematical thought through the ages. Topics may include equation solving, trigonometry, astronomy, and calculus. Prerequisite: MAC 2312. (F)

MHF 4102 Axiomatic Set Theory (3). Axioms of set theory, order and well-foundedness, cardinal numbers, ordinal numbers, axiom of choice, special topics. Prerequisites: MAA 3200 or permission of the instructor. (S, alternate years)

MHF 4302 Mathematical Logic (3). A study of formal logical systems and their applications to the foundations of mathematics. Topics to be selected from the following: definition of mathematical proofs; set theory; analysis formalized with the predicate calculus; theorem of Godel and Church; recursive function theory; and idealized computers. Prerequisites: MAA 3200 or MAD 3512. (S, alternate years)

MHF 4401 Methods in the History of Modern Mathematics – *GL* (3). Galileo and his time; Newton, and the laws of gravitation. Einstein and the theory of relativity; topics in differential geometry and non-Euclidean geometries Prerequisite: MAC 2313 and MAS 3105.

MHF 5107 Graduate Set Theory (3). Zermelo-Frankel axioms, ordinals and cardinals, Godel's constructible universe, large cardinals, forcing and the independence of the Continuum Hypothesis and the Axiom of Choice. Prerequisites: MHF 4102 or MAA 4211 or permission of the instructor.

MHF 5306 Graduate Mathematical Logic (3). First order languages, construction of models from constants, advanced construction of models, non-standard models, recursion theory, RE sets, Turing degrees, oracle construction. Prerequisites: MHF 4302 or permission of the instructor.

MHF 5325 Theory of Recursive Functions (3). Turing machines, decision problems, coding, s-m-n theorem, Rice's and Myhill's theorems, oracles, degrees, finite and infinite injury constructions. Prerequisite: MHF 4302 or COT 5310.

MHF 5345 Mathematical Logic for Linguistics (3). Formal logical systems and applications. Propositional and predicate calculus, proof systems, completeness and incompleteness theorems, recursion. Chomsky hierarchy, formal grammars. Does not fulfill requirements for Mathematics Degree. Prerequisites: MAD 3512 or permission of the instructor.

MHF 5930 Topics in Modern Mathematics (3). Designed to provide student with the opportunity to pursue topics not otherwise covered in other courses. Prerequisites: MAC 2313, MAS 3105.

MTG 1204 Geometry for Education (3). Introduction for teachers to basic concepts of Euclidean geometry with ideas and activities adaptable to classroom. Students study and analyze pattern, learning and enhancing analytic, creative and visualization skills.

MTG 3212 College Geometry (3). A study of the basic structure of Euclidean geometry together with topics from advanced Euclidean geometry and non-Euclidean geometry. Prerequisites: Calculus II or permission of the instructor. (F)

MTG 4254 Differential Geometry (3). Hypersurfaces in R^n. Geodesics and curvature. Parametrization of surfaces, abstract manifolds. Integration, surfaces with boundary, Stokes Theorem. Isometries and intrinsic geometry. Gauss-Bonnet Theorem. Prerequisites: MAC 2313, MAS 3105, and MAP 2302 or permission of the instructor.

MTG 4302 Topology (3). An introductory course in topology requiring a prerequisite knowledge of calculus. Topics to be discussed will be selected from the following: topological spaces, metric spaces, continuity, completeness, compactness, separation axioms, products spaces, subspaces, convergence, and homotopy theory. Prerequisites: MAC 2313, MAS 3105, and MAA 3200. (SS)

MTG 5326 Introduction to Algebraic Topology (3). Classification of surfaces, fundamental group, homotopy type, Van Kampen theorem, simplicial complexes, introduction to homology theory. Prerequisites: MAS 4301 and MTG 4302.

STA 1013 Statistics for Social Services (3). This is an elementary course in statistics, covering graphical and numerical condensation of data as well as the most basic parametric and non-parametric methods. Emphasis is placed on the interpretation of statistical results, rather than on ways to analyze experimental data. Prerequisite: High school algebra.

STA 1061 Introduction to SPSSX for Data Analysis (1). Data coding and entry for use on the mainframe. How to input data, create variables, select subsets of data. Use procedures such as: LIST, FREQUENCIES, CROSSTABS, DESCRIPTIVES, MEANS and CORRELATIONS. Prerequisite: A course in statistics.

STA 1062 Introduction to SAS for Data Analysis (1). Data coding for entry use on the mainframe. SAS Data step to input data, create variables, select subsets of data, PROCs such as: PRINT, FORMAT, MEANS, FREQ, SUMMARY, TEST, CORR, UNI-VARIATE and PLOT. Prerequisite: A course in statistics.

STA 2023 Statistics for Business and Economics (3). Starting with an introduction to probability, the course provides an introduction to statistical techniques used in management science. It includes descriptive statistics, probability distributions, estimation and testing of hypotheses. Subsequent credit for STA 2122 or STA 3111 will not be granted. Prerequisite: High school algebra. (F,S,SS)

STA 2122 Statistics for Behavioral and Social Sciences I (3). A course in descriptive and inferential statistics. Topics include: probability distribution of discrete and continuous random variables. Sampling distributions. Large sample estimation and hypothesis testing for means and proportions. Prerequisite: High school algebra. (F,S,SS)

STA 3033 Introduction to Probability and Statistics for CS (3). Basic probability laws, probability distributions, basic sampling theory, point and interval estimation, tests of hypotheses, regression and correlation. Prerequisite: MAC 2312. (F,S,SS)

STA 3060L Statistics Laboratory (1). A laboratory course designed to illustrate important statistical concepts through experiments. Data are analyzed using statistical software packages. Prerequisite or Corequisite: A statistics course.

STA 3111 Statistics I (3). Descriptive statistics. Basic probability rules. Discrete and continuous probability distributions. Point and interval estimation, hypothesis testing based on a single sample. Comparison of two proportions using independent and large samples. Subsequent credit for STA 2122 or STA 2023 will not be granted. Prerequisite: High school algebra. (F,S,SS)

STA 3112 Statistics II (3). Estimation and hypothesis testing based on two samples. Analysis of Variance. Simple linear regression. Linear correlation. Analysis of categorical data. Non-parametric methods. Use of statistical software packages. Subsequent credit for STA 3123 will not be granted. Prerequisite: STA 3111. (F,S,SS)

STA 3123 Statistics for Behavioral and Social Sciences II (3). Small sample statistical inference for means and variances. T, chi-square and F distributions. Analysis of variance, regression, correlation, basic nonparametric tests, goodness of fit tests and tests of independence. Prerequisites: STA 2122 or STA 2023 or equivalent. (F,S,SS)

STA 3145 Statistics for the Health Professions (3). Statistical analysis with applications in the health sciences. Binomial and normal distributions. Inferences about means and proportions. Regression, correlation, goodness of fit tests. Prerequisite: High school algebra. (F,S,SS)

STA 3163 Statistical Methods I (3). This course presents tools for the analysis of data. Specific topics include: use of normal distribution, tests of means, variances and proportions; the analysis of variance and covariance (including contrasts and components of variance models), regression, correlation, sequential analysis, and non-parametric analysis. Prerequisites: A course in statistics or STA 2122 or MAC 2312 or equivalent. (F,S)

STA 3164 Statistical Methods II (3). This course presents tools for the analysis of data. Specific topics include: use of normal distribution, tests of means, variances and proportions; the analysis of variance and covariance (including contrasts and components of variance models), regression, correlation, sequential analysis, and non-parametric analysis. Prerequisite: STA 3163. (F,S)

STA 3193 Statistics for Biology I (3). Graphical data analysis; probability distributions, estimation, test of hypothesis. Statistical models used in the biological sciences, and testing for distributional assumptions used with these models. Prerequisites: MAC 2312, BSC 2011 and permission of the instructor.

STA 3194 Statistics for Biology II (3). Analysis of variance, correlation, regression, discrete data analysis, analysis of covariance and non-parametric procedures. Introduction to design of experiments, bio assay, logistic regression and multivariate analysis. Prerequisites: STA 3193 and permission of the instructor.

STA 3905 Independent Study (1-6). Individual conferences, assigned readings, and reports on independent investigations.

STA 3930 Special Topics (1-6). A course designed to give groups of students an opportunity to pursue special studies not otherwise offered.

STA 3949 Cooperative Education in Statistics (1-3). One semester of either part-time or full-time work in an outside organization. Limited to students admitted to the Co-op program. A written report and supervisor evaluation are required of each student. Prerequisites: 2 courses in statistics and permission of Chairperson.

STA 3951 Oral Presentations in Statistics – *GL* (1). Students will communicate orally all stages of statistical analysis through a presentation in front of faculty and students. The problem must have a global component to be explained by the student. Prerequisites: ENC 3213 and STA 3164 or equivalent. (F,S,SS)

STA 4102 Introduction to Statistical Computing (3). Data manipulation and statistical procedures using popular software, simulation, and statistical algorithms.

Prerequisites: STA 3112 or STA 3123 or STA 3164, and COP 2210.

STA 4173-HSC 4510 Statistical Applications in Health Care (3). A course in descriptive and inferential statistics for the Health Services. Topics include probability distributions, point and interval estimation, hypothesis testing, regression and correlation, and contingency table analysis. Prerequisites: STA 1013 or equivalent college mathematics course.

STA 4182 Statistical Models (3). This is a specialized course in the use of statistical models to represent physical and social phenomena. The emphasis is on providing tools which will allow a researcher or analyst to gain some insight into phenomena being studied. An introductory knowledge of probability theory and random variables is assumed. Specific topics include: introduction to discrete and continuous probability distributions, transformation of variables, approximation of data by empirical distributions, central limit theorem, propagation of moments, Monte Carlo simulation, probability plotting, testing distributional assumptions. Prerequisites: STA 3033 or STA 4321.

STA 4202 Introduction to Design of Experiments (3). Completely randomized, randomized block, Latin square, factorial, nested and related designs. Multiple comparisons. Credit will not be given for both STA 4202 and STA 5206. Prerequisites: STA 3163 or STA 3112 or STA 3123 or STA 4322.

STA 4321-STA 4322 Introduction to Mathematical Statistics I and II (3-3). This course presents an introduction to the mathematics underlying the concepts of statistical analysis. It is based on a solid grounding in probability theory, and requires a knowledge of single and multivariable calculus. Specific topics include the following: basic probability concepts, random variables, probability densities, expectations, moment generating functions, sampling distributions, decision theory, estimation, hypothesis testing (parametric and non-parametric), regression, analysis of variance, and design of experiments. Prerequisite: MAC 2313. (F,S)

STA 4234 Introduction to Regression Analysis (3). Multiple and polynomial regression, residual analysis, model identification and other related topics. Credit will not be given for both STA 4234 and STA 5236. Prerequisites: STA 3112 or STA 3123 or STA 3164.

STA 4502 Introduction to Non-parametric Methods (3). Sign, Mann-Whitney U, Wilcoxon signed rank, Kruskal-Wallis, Friedman and other distribution-free tests. Rank correlation, contingency tables and other related topics. Credit for both STA 4502 and STA 5507 will not be granted. Prerequisite: A course in statistics.

STA 4603 Mathematical Techniques of Operations Research I (3). An introduction to those topics in mathematics associated with studies in operations research. Topics include the following: linear programming and related topics, dynamic programming, queuing theory, computer simulation, network analysis, inventory theory, decision theory, integer programming. Prerequisites: MAS 3105, STA 3033 or STA 4322 “C”.

STA 4604 Mathematical Techniques of Operations Research II (3). An introduction to those topics in mathematics associated with studies in operations research. Topics include the following: linear programming and related topics, dynamic programming, queuing theory, computer simulation, network analysis, inventory theory, decision theory, integer programming. Prerequisite: STA 4603.

STA 4664 Statistical Quality Control (3). This course presents the simple but powerful statistical techniques employed by industry to improve product quality and to reduce the cost of scrap. The course includes the use and construction of control charts (means, percentages, number defectives, ranges) and acceptance sampling plans (single and double). Standard sampling techniques such as MIL STD plans will be reviewed. Prerequisite: A course in statistics.

STA 4905 Independent Study (1-6). Individual conferences, assigned readings, and reports on independent investigations.

STA 4930 Special Topics (1-6). Designed to give students an opportunity to pursue special studies not otherwise offered. May be repeated.

STA 4949 Cooperative Education in Statistics (1-3). One semester of either part-time or full-time work, in an outside organization. Limited to students admitted to the Co-op program. A written report and supervisor evaluation are required of each student. Prerequisites: STA 3164, STA 4322 and permission of Chairperson.

STA 5065L SAS Data Analysis Lab (1). Entering data, descriptive statistics, graphing data, crosstabulations, t-tests, correlation and regression, and analysis of variance. Prerequisites: A statistics course and graduate standing or permission of the instructor.

STA 5105L SPSS Data Analysis Lab (1). Topics include: Entering data from various sources, data checking, descriptive statistics, graphing data, cross tabulations, tests, correlation and regression, ANOVA, and reliability. Prerequisites: A statistics course or concurrent enrollment in a statistics course, and graduate standing or permission of the instructor. (F,S,SS)

STA 5106 Intermediate Statistics I (3). Power, measures of assoc., measurement, ANOVA: one-way and factorial, between and within subjects expected mean squares, planned comparisons, a-priori contrasts, fixed, random, mixed models. This course may be of particular interest to behavioral sciences. Prerequisites: STA 3111 or STA 3123 or STA 3033; and graduate standing. (F)

STA 5107 Intermediate Statistics II (3). Correlation and regression both simple and multiple, general linear model, analysis of covariance, analysis of nominal data, analysis of categorical data. This course may be of particular interest to behavioral sciences. Prerequisite: Permission of the instructor. (S)

STA 5126-PSY 5206 Fundamentals of Design of Experiments (3). CRD and RCB designs. Latin square designs. Factorial, nested and nested-factorial experiments. Fixed, random and mixed models. Split-plot designs. Covariance analysis. Prerequisites: STA 3112 or STA 3123 or STA 3163 or STA 4322 or equivalent.

STA 5206 Design of Experiments I (3). Design and analysis of completely randomized block, Latin square factorial, nested experiments. Multiple comparisons. Credit for only one of three STA 4202, STA 5126, and STA 5206 courses will be granted. Prerequisites: STA 3033 or STA 3164 or STA 4322 or (STA 3163 and STA 4321).

STA 5207 Topics in Design of Experiments (3). This applied course in design of experiments covers topics such as split-plot design, confounding, fractional replication, incomplete block designs, and response surface designs. Prerequisite: STA 5206.

STA 5236 Regression Analysis (3). Simple, multiple and polynomial regression, analysis of residuals, model building and other related topics. Credit for both STA 4234 and STA 5236 will not be granted. Prerequisites: STA 3112 or STA 3123 or STA 3164, or STA 6167.

STA 5446-STA 5447 Probability Theory I and II (3-3). This course is designed to acquaint the student with the basic fundamentals of probability theory. It reviews the basic foundations of probability theory, covering such topics as discrete probability spaces, random walk, Markov Chains (transition matrix and ergodic properties), strong laws of probability, convergence theorems, and law of iterated logarithm. Prerequisite: MAC 2313.

STA 5507 Nonparametric Methods (3). Distribution-free tests: Sign, Mann-Whitney U-, Wilcoxon signed rank, Kruskal-Wallis, Friedman, etc. Rank correlation, contingency tables and other related topics. Credit for both STA 4502 and STA 5507 will not be granted. Prerequisite: A course in statistics.

STA 5666 Advanced Statistical Quality Control (3). Review of statistical methods useful in quality improvement. Statistical process control. Taguchi's and Deming's philosophies. Control charts. Process capability analysis. Acceptance sampling plans. Prerequisites: STA 3033 or STA 3163 or STA 4321 or equivalent.

STA 5676 Reliability Engineering (3). The course material is designed to give the student a basic understanding of the statistical and mathematical techniques which are used in engineering reliability analysis. A review will be made of the basic fundamental statistical techniques required. Subjects covered include: distributions used in reliability (exponential, binomial, extreme value, etc.); tests of hypotheses of failure rates; prediction of component reliability; system reliability prediction; and reliability apportionment. Prerequisite: STA 4322.

STA 5800 Stochastic Processes for Engineers (3). Probability and conditional probability distributions of a random variable, bivariate probability distributions, multiple random variables, stationary processes, Poisson and normal processes. Prerequisites: MAC 2313, MAP 2302, STA 3033.

STA 5826 Stochastic Processes (3). This course is intended to provide the student with the basic concepts of stochastic processes, and the use of such techniques in the analysis of systems. Subjects include: Markov Processes, queuing theory, renewal processes, birth and death processes, Poisson and Normal processes. Applications to system reliability analysis, behavioral science, and natural sciences will be stressed. Prerequisite: STA 5447.

STA 5906 Independent Study (1-6). Individual conferences, assigned reading, and reports on independent investigation.