



MATHEMATICS

Chairperson Professor Martha Hunt

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Faculty Emeriti

Professors: Said AbuZahra, Joyce Anderson-Cryan, Yuk Keung Cheung, Kenneth Griswold, Harold Harutunian, Robert Kalechofsky, Thomas J. Kryouz, Woon Chung Lam, Robert Mooney, Radhagbinda Nath, Jamal Shahin, Peter C. Wong

PROGRAMS OFFERED

Bachelor of Arts – Mathematics

Bachelor of Science – Mathematics

Concentration

Computer Science

Minors

Mathematics

Secondary Education

The Mathematics Program

Mathematics is the language of science, providing a framework for analyzing the world by abstracting from our observations that which is essential to the question at hand. An understanding of mathematics gives its owner a powerful approach to solving problems through organization, simplification, and abstraction. This approach often leads to solutions and techniques of great beauty, independent of their application, and it is the aim of the Department of Mathematics to furnish its majors and general studies students with some of this understanding and an appreciation of this beauty.

In today's job market, individuals with highly developed analytical and problem-solving skills are in great demand and so there are a number of career options open to students who choose to major in mathematics. These include careers in secondary education, actuarial mathematics, operations research, and information technology. Students who intend to teach secondary mathematics must major in mathematics and are encouraged to minor in secondary education.

The Mathematics Minor

To earn a minor in Mathematics, a student must satisfy each of the following requirements.

1. Successful completion of MAT 220: Calculus I and MAT 221: Calculus II.
2. Successful completion of nine credits from the list that includes MAT 214: Discrete Structures, MAT 247: Statistics I, and all Mathematics courses numbered 300 or higher. At least six of these credits must be for courses numbered 300 or higher.

The Secondary Education Minor

The minor in Secondary Education from the Mathematics Department leads to achieving initial licensure. To earn a minor in Secondary Education from the Mathematics Department, a student must do all of the following:

1. Satisfy the requirements for a major in Mathematics. MAT 405 and MAT 407 are required electives for mathematics majors who minor in secondary education.
2. Satisfy requirements outlined under the heading "Admission to Licensure Programs" in the Education Department's section of this catalog.
3. Successfully complete either HIS 204, HIS 208 or HIS 319.
4. Successfully complete the following courses: EDU 252A, EDU 254A, EDU 256A, EDU 260A, EDU 337M, EDU 495,

(Practicum in Student Teaching in Secondary Education), and PSY 252.

SPECIAL PROGRAMS AND RESOURCES

Honors

The awarding of departmental honors to a Mathematics major signifies that the student has both a superior knowledge of the subject and has completed a substantial creative achievement outside of the normal pattern of Mathematics courses. To receive honors, Mathematics majors must have a GPA of at least 3.5 in their Mathematics courses and complete an honors project supervised by a Mathematics faculty member and approved by a departmental honors committee. Interested students should consult with the Department Chairperson.

Lathrop Award

The Thomas G. Lathrop Award is a monetary award presented annually since 1980 in memory of Professor Thomas G. Lathrop. The award is presented to students who have demonstrated excellence in Mathematics or Computer Science at Salem State. Students are selected based on recommendations by faculty in the Mathematics and Computer Science departments and on their overall achievements in Mathematics and Computer Science courses. The funding of the award is provided entirely by contributions from the Lathrop family and from members of the Salem State community and it is independent of college funds.

The Math Lab

The Math Lab is located in Room 306 in the Sullivan Building (ext. 6348). One half of the lab consists of a tutoring section where students can meet to work on assignments or study with their classmates. This section is supervised by Jane Claffey, a full-time staff member of the Mathematics Department. In addition, there is a tutoring staff of undergraduate and graduate students with a special interest in Mathematics who are competent in the introductory undergraduate Mathematics courses. The other half of the lab contains nineteen Dell computers equipped with a variety of mathematical and office software for student use. This section is supervised by Michael Nourai, a staff member of both the Mathematics and Computer Science Departments. The services of the Math Lab are free and require no reservations for all Salem State students.

Math Society

The Math Society is a student organization open to any Salem State College student interested in mathematics. The Society sponsors a variety of events in cooperation with the Mathematics Department. Students interested in joining are encouraged to contact any member of the Mathematics Department.

The Basic College Mathematics Competency Requirements

To receive a degree from Salem State College, a student must demonstrate competency in Basic College Mathematics. The Registrar's Office is responsible for certifying that this requirement has been satisfied by all students before graduation. The basic college Mathematics requirement can be satisfied by doing any of the following:

1. By achieving a score of 500 or above on the SAT Mathematics examination.
2. By achieving a score of 72 on the Accuplacer College-Level Mathematics test.
3. By achieving a score in the 50th percentile or above on the CLEP College Algebra-Trigonometry Exam.
4. By successfully completing MAT 90.



Mathematics
Salem State College
Advisor: _____

Name: _____
Date admitted into Major: _____
Transfer credits: _____

**BACHELOR OF ARTS
MATHEMATICS**

CORE REQUIREMENTS

Competency-Based Skills

- @ Basic College Math
- @ Reading Comprehension
- @ Computer Literacy

@	ENG	101	Composition I	3	_____
@	ENG	102	Composition II	3	_____
@	SPC	101	(Speech)	3	_____
@	SFL	194	Health and Wellness	3	_____

Physical Education Activities (1 cr. total)

@	SFL	_____	_____	_____	_____
@	SFL	_____	_____	_____	_____

Distribution Sequences (18-20 credits)

_____	_____	(Literature I)	3	_____	
_____	_____	(Literature II)	3	_____	
_____	_____	(Lab Science I)	3-4	_____	
_____	_____	(Lab Science II)	3-4	_____	
@	HIS	101	History of World Civilization I	3	_____
@	HIS	_____	(History II)	3	_____

Distribution Electives (18 credits)

Among the distribution electives, the student must earn at least 3 but no more than 9 additional semester hours in each of the three divisions.

Humanities (Division I)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Science/Mathematics (Division II)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Social Sciences (Division III)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

(Note: Courses allowable as distribution electives are marked 'D' in the College Catalog or indicated by appropriate footnotes.)

COURSES IN MAJOR (36 credits)

MAT	220	Calculus I	4	_____
MAT	221	Calculus II	4	_____
MAT	303	Modern Algebra	3	_____
MAT	304A	Linear Algebra	3	_____
MAT	320	Calculus III	4	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____

Also required are six courses from the approved list.
Approved List: 214, 306, 308, 314, 316, 323, 404, 405, 407, 409, 410, 411, 412, 413, 414, 415, 417, 421, 424, 427

*** MINOR: _____ (15-18 credits)**

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

FOREIGN LANGUAGE (12 credits)

_____	_____	_____	3	_____
_____	_____	_____	3	_____
_____	_____	_____	3	_____
_____	_____	_____	3	_____

FREE ELECTIVES (minimum: 10 credits)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

@ Requirements so marked should be completed within the first 53 credits of study (i.e., before Junior status). Exceptions will be made for transfer students.
* Secondary Education minor: requires Mathematics majors to complete MAT405 and MAT407.

Note: If a course is used to satisfy two or more requirements (for example, a support course and a distribution elective), the credits are counted in only one place. Using a course to satisfy more than one requirement does **not** reduce the credit total required for graduation.



Mathematics
Salem State College
Advisor: _____

Name: _____
Date admitted into Major: _____
Transfer credits: _____

BACHELOR OF SCIENCE
MATHEMATICS

CORE REQUIREMENTS

Competency-Based Skills

- @ Basic College Math
@ Reading Comprehension
@ Computer Literacy

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking. Includes ENG 101, ENG 102, SPC 101, SFL 194, and Physical Education Activities.

Distribution Sequences (18-20 credits)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking. Includes Literature I/II, Lab Science I/II, and HIS 101.

Distribution Electives (18 credits)

Among the distribution electives, the student must earn at least 3 but no more than 9 additional semester hours in each of the three divisions.

Humanities (Division I)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking.

Science/Mathematics (Division II)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking.

Social Sciences (Division III)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking.

(Note: Courses allowable as distribution electives are marked 'D' in the College Catalog or indicated by appropriate footnotes.)

COURSES IN MAJOR (36 credits)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking. Includes MAT 220, MAT 221, MAT 303, MAT 304A, and MAT 320.

Also required are six courses from the approved list.
Approved List: 214, 306, 308, 314, 316, 323, 404, 405, 407, 409, 410, 411, 412, 413, 414, 415, 417, 421, 424, 427

FREE ELECTIVES (minimum: 40 credits)

Table with 4 columns: Course ID, Title, Credits, and a blank line for marking.

@ Requirements so marked should be completed within the first 53 credits of study (i.e., before Junior status). Exceptions will be made for transfer students.
While the Department does not require a minor, it encourages minors in areas related to the concentration.
Secondary Education minor: Requires Mathematics majors to complete MAT 405 and MAT 407.
Note: If a course is used to satisfy two or more requirements (for example, a support course and a distribution elective), the credits are counted in only one place. Using a course to satisfy more than one requirement does not reduce the credit total required for graduation.

Total credits for graduation: 127

Effective: 9/04



Mathematics
Salem State College
Advisor: _____

Name: _____
Date admitted into Major: _____
Transfer credits: _____

**BACHELOR OF SCIENCE
MATHEMATICS
COMPUTER SCIENCE CONCENTRATION**

CORE REQUIREMENTS

Competency-Based Skills

- @ Basic College Math
- @ Reading Comprehension
- @ Computer Literacy

@	ENG	101	Composition I	3	_____
@	ENG	102	Composition II	3	_____
@	SPC	101	(Speech)	3	_____
@	SFL	194	Health and Wellness	3	_____

Physical Education Activities (1 cr. total)

@	SFL	_____	_____	_____	_____
@	SFL	_____	_____	_____	_____

Distribution Sequences (18-20 credits)

_____	_____	(Literature I)	3	_____	
_____	_____	(Literature II)	3	_____	
_____	_____	(Lab Science I)	3-4	_____	
_____	_____	(Lab Science II)	3-4	_____	
@	HIS	101	History of World Civilization I	3	_____
@	HIS	_____	(History II)	3	_____

Distribution Electives (18 credits)

Among the distribution electives, the student must earn at least 3 but no more than 9 additional semester hours in each of the three divisions.

Humanities (Division I)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Science/Mathematics (Division II)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Social Sciences (Division III)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

(Note: Courses allowable as distribution electives are marked 'D' in the College Catalog or indicated by appropriate footnotes.)

COURSES IN MAJOR (36 credits)

MAT	220	Calculus I	4	_____
MAT	221	Calculus II	4	_____
MAT	303	Modern Algebra	3	_____
MAT	304A	Linear Algebra	3	_____
MAT	320	Calculus III	4	_____
MAT	214	Discrete Structures	3	_____
MAT	316	Combinatorial Mathematics	3	_____
MAT	323	Numerical Analysis	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____
MAT	_____	_____	3	_____

Also required are three courses from the approved list.

Approved List: 306, 308, 314, 404, 405, 407, 409, 410, 411, 412, 413, 414, 415, 417, 421, 424, 427

MINOR IN COMPUTER STUDIES (18-19 credits)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

FREE ELECTIVES (minimum: 21 credits)

_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

@ Requirements so marked should be completed within the first 53 credits of study (i.e., before Junior status). Exceptions will be made for transfer students.

Secondary Education minor: Requires Mathematics majors to complete MAT 405 and MAT 407.

Note: If a course is used to satisfy two or more requirements (for example, a support course and a distribution elective), the credits are counted in only one place. Using a course to satisfy more than one requirement does **not** reduce the credit total required for graduation.

Total credits for graduation: 127

Effective: 9/04



COURSE DESCRIPTIONS

MATHEMATICS

MAT 090 Basic Algebra 3 non degree credits

This course is intended to develop those ideas, computational techniques, and methods of reasoning used in college mathematics, with an emphasis on algebra needed to formulate and solve first and second degree equations, constructing models using linear and quadratic functions, and concepts of coordinate geometry. Only for students entering Fall 1999 or later who have not passed either the Accuplacer Elementary Algebra Test or the College Level Math Test or for those students who entered before Fall 1999 who have not satisfied the Basic Mathematics Competency Requirement. Does not give degree credits. Three lecture hours per week.

MAT 108 Finite Mathematics 3 credits DII

This course will include sets, real numbers, inequalities, the straight line, functions, operations on matrices, systems of equations, inverse of a matrix, linear programming, the Simplex method, counting, permutations and combinations, sample spaces, and probability. Three lecture hours per week.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 120 Mathematics for the Liberal Arts 3 credits DII

This course is designed to give the liberal arts student, as well as other interested students, an introduction to some mathematical topics usually reserved for specialists. Topics are selected on the basis of their role in solving mathematical problems. Such topics include probability and descriptive statistics, graph theory, cryptography, game theory, chaos, and problems relating to the environment. Classroom lectures and discussions cover the basic theories. These are followed by writing assignments, which form an essential component of the course. Not open to students who have completed MAT 103 or MAT 113. Not open to math majors without the permission of the Department Chairperson.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 123A Mathematics for the Elementary and Middle School Teacher I 3 credits DII

This course is designed for prospective elementary and middle school teachers. Those mathematical concepts which schoolteachers will be teaching are stressed. Topics include: Numeration systems, algorithms and estimation for the arithmetic operations on different sets of numbers, number theory, and probability concepts. Use of manipulatives and relevant technology including graphing calculators and computer software may be integrated into the course. Not open to students who have received credits for MAT 123. Three lecture hours per week.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 202N Precalculus 3 credits DII

This course is intended to prepare the student for the study of Calculus. Topics include: properties of the real number systems; absolute values, inequalities; detailed study of linear and quadratic equations; polynomial and rational functions and their graphs; exponential, logarithmic, and trigonometric functions. Three lecture hours per week. Not open to students who have received credits for MAT 202.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 205 Analytic Geometry 3 credits DII

Properties of straight lines, conic sections and other algebraic curves, transcendental curves, polar coordinates, introduction to vectors and elementary 3-dimensional geometry. Not open to Math Majors without permission of the Department Chairperson. Three lecture hours per week.

MAT 208 Business Calculus 3 credits DII

Introduction to calculus as applied to business. Differentiation, integration, and their applications are considered in conjunction with polynomial, algebraic, exponential, and logarithmic functions. Three lecture hours per week. Not open to students who have completed MAT 111.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 214 Discrete Structures 3 credits DII

A study of discrete mathematical structures of interest in computer science and other applied fields. Applications-oriented study of formal logic, algebra of sets, permutations and combinations, mathematical induction, recursion, graphs, trees, logic gates and circuits and finite state machines. Three lecture hours per week. Not open to students who have received credits for MAT 314.

Prerequisite: MAT 210 or MAT 220.

MAT 220 Calculus I 4 credits DII

This course includes functions and their limits, slopes and tangent lines, differentiation rules (including those for trigonometric functions). Chain Rule, linearizations, approximations, Newton's Method, extreme values and curve sketching, optimization and the Mean Value Theorem and its applications. Also included is an introduction to integration with applications to area between curves, the Fundamental Theorems of Integral Calculus and the basic integration techniques. Four lecture hours per week. Not open to students who have received credits for MAT 210.

Prerequisite: Knowledge of algebra and trigonometry is assumed.

MAT 221 Calculus II 4 credits DII

This course is a further development of the calculus of functions of one variable. Topics include logarithmic and exponential functions and their derivatives and integrals, exponential growth and decay, inverse trigonometric functions, techniques of integration, numerical integration with error estimates, applications of the integral indeterminate forms and l'Hospital's rule, infinite sequences and infinite series with error estimation. Not open to students who have received credits for MAT 211. Four lecture hours per week.

Prerequisite: MAT 220.

MAT 223A Mathematics for the Elementary and Middle School Teacher II 3 credits DII

This course is designed for prospective elementary and middle school teachers. Those mathematical concepts which schoolteachers will be teaching are stressed. Topics include: geometric figures and solids, congruence, similarity, constructions, measurement including perimeter, area, surface area and volume, geometric transformations, descriptive statistics. Use of manipulatives and relevant technology including graphing calculators and computer software may be integrated into the course. Not open to students who have received credits for MAT 223. Three lecture hours per week.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency.

**MAT 247 Statistics I****3 credits DII**

An elementary introduction to statistical concepts, probability, frequency distributions, sampling, testing of hypotheses, and linear regression. The emphasis is on practical and usable results, rather than on mathematical derivations. This course can prepare the student for the use of statistics in business, economics, the social sciences, or education. Not open to Math majors without permission of the Department Chairperson. Three lecture hours per week.

Prerequisite: For students entering Fall 1999 or later, passing score on the Accuplacer Elementary Algebra Test or the College Level Math Test. For students who entered before Fall 1999, completion of the Basic College Mathematics Competency Requirement.

MAT 250H Honors Calculus I (Fall)**3 credits DII**

This course is intended to offer a stimulating and challenging mathematics course for Honors students. The topics included will be those ordinarily covered in Calculus I, but they will be approached in a more rigorous and sophisticated way. Additional topics will include matrices, linear systems, and linear programming. Open only to Honors Program students. Three lecture hours per week.

MAT 251H Honors Calculus II (Spring)**3 credits DII**

This course is a continuation of MAT 250H for Honors students. The topics included will be those ordinarily covered in Calculus II, but they will be approached in a more rigorous and sophisticated way. In addition, topics in the mathematics of finance will be included. Open only to Honors Program students. Three lecture hours per week.

MAT 303 Modern Algebra**3 credits DII**

This course provides a systematic study of the most common and useful rings and groups: integers, rational numbers, real numbers, complex numbers, residue classes, polynomials, and matrices. Both computational and structural aspects are treated. Three lecture hours per week.

Prerequisite: MAT 214 or MAT 221.

MAT 304A Linear Algebra I**3 credits DII**

A systematic study of vector spaces and linear transformations including the algebra of matrices, determinants, inner products, eigenvalues, and eigenvectors. Three lecture hours per week.

Prerequisite: MAT 214 or MAT 221.

MAT 306 Theory of Numbers**3 credits**

An introduction to divisibility theory, prime numbers, congruences, Diophantine equations, number-theoretic functions, primitive roots and indices, and quadratic residues. Three lecture hours per week.

Prerequisite: MAT 303.

MAT 308 Linear Programming**3 credits DII**

Topics studied: linear equations and inequalities, convex regions, the simplex algorithm, duality and minimax theorems, matrix games, transportation and assignment problems. Experience is provided in the computer solution of linear programming problems and in applications to business and the sciences. Three lecture hours per week.

Prerequisite: MAT 210 or MAT 220 or equivalent.

MAT 314 Discrete Mathematics**3 credits**

Topics include finite-state machines, feedback, partially ordered sets, lattices, recursion and iteration, with applications to logic, circuit design, and computer systems. Three lecture hours per week.

Prerequisite: MAT 303.

MAT 316 Combinatorial Mathematics**3 credits**

A survey of combinatorial methods, including graphs, trees, networks, permutations and combinations, partitions, and enumeration theory. Three lecture hours per week.

Prerequisite: MAT 214 or MAT 221.

MAT 320 Calculus III**4 credits**

This course extends important ideas of single variable calculus to higher dimensional settings. Topics include polar coordinates and calculus using polar coordinates, vector algebra and vector valued functions, cylindrical and spherical coordinates, calculus of multi-variable functions (partial derivatives, limits, continuity, directional derivatives, gradients, Chain Rule), tangent planes and approximation, maxima and minima, double and triple integrals in Cartesian, cylindrical, and spherical coordinates. Four lecture hours per week. Not open to students who have received credits for MAT 310 or MAT 311.

Prerequisite: MAT 221.

MAT 323 Numerical Analysis**3 credits**

A study of numerical methods. Topics include root finding for non-linear equations, polynomial interpolation, series methods, numerical integration, finite differences, and solutions of linear systems. Efficiency, accuracy and round off and truncation errors are considered. Computer implementation of selected methods is included. Three lecture hours per week.

Prerequisites: MAT 221.

MAT 404 Algebraic Structures**3 credits**

Topics include normal subgroups, ideals, morphisms of groups and rings, fields and field extensions with examples and applications. Three lecture hours per week.

Prerequisite: MAT 303.

MAT 405 Foundations of Geometry**3 credits**

A study of various approaches to the axiomatic development of Euclidean plane geometry, followed by a treatment of non-Euclidean geometries, construction problems, and other special topics. Three lecture hours per week. Required of all Mathematics majors with a Secondary Education Minor.

Prerequisite: MAT 210 or MAT 220.

MAT 407 Probability and Mathematical Statistics I**3 credits**

Topics include: probability models, random variables and their probability distributions, expectation, variance, moment and moment generating functions, regression and correlation. The binomial, Poisson, exponential, normal, chi-square, t and F distributions will also be studied. Three lecture hours per week. Required of all Mathematics majors with a Secondary Education Minor

Prerequisite: MAT 221 or MAT 310.

MAT 409 Complex Variables**3 credits**

Functions of a complex variable. Cauchy-Riemann equations, Cauchy's integral theorem and formula, the calculus of residues, series expansions of analytic functions, singularities, and contour integration will be discussed. Three lecture hours per week.

Prerequisite: MAT 221 or MAT 310.

MAT 410 History of Mathematics**3 credits**

A survey of the fundamental developments in mathematics from ancient to modern times, with special attention to the historical and logical bases of geometry, algebra, and analysis. Three lecture hours per week.

Prerequisites: MAT 303.

MAT 411 Real Analysis**3 credits**

A rigorous treatment of the theorems on sequences, limits, continuity, derivatives, and integrals which are fundamental to all of real analysis. Three lecture hours per week.

Prerequisite: MAT 221 or MAT 310.

MAT 412 Topology**3 credits**

Topics include topological spaces, metric spaces, connectedness, compactness, and product and quotient spaces; additional topics as time permits. Three lecture hours per week.

Prerequisite: MAT 411.

MAT 413 Ordinary Differential Equations**3 credits**

The methods of solving linear and elementary nonlinear ordinary differential equations; variation of parameters, series solutions, Laplace transforms and applications. Three lecture hours per week.

Prerequisite: MAT 221 or MAT 310.



MAT 414 Linear Algebra II 3 credits
A continuation of Linear Algebra I. Topics include inner product spaces, canonical forms, quadratic forms, and similarity, Hermitian, Unitary, and normal transformations. Three lecture hours per week. Prerequisite: MAT 304A.

MAT 415 Geometric Structures 3 credits
An analysis of various geometric structures, especially projective geometry and its relation to certain algebraic structures. Three lecture hours per week. Prerequisite: MAT 303.

MAT 417 Probability and Mathematical Statistics II 3 credits
Introduction to statistical inference, sampling distributions, decision theory, theory of estimations, tests of hypotheses, analysis of variance. Three lecture hours per week. Prerequisite: MAT 407.

MAT 420 Special Problems Seminar 3 credits
Topics to be selected by the instructor. Prerequisite: MAT 303.

MAT 421 Advanced Calculus 3 credits
Functions of several variables, implicit functions and Jacobian determinants, line and surface integrals, and the theorems of Green and Stokes will be discussed. Three lecture hours per week. Prerequisite: MAT 320 or MAT 311.

MAT 424 Operations Research 3 credits
Theory of games, functional equations, dynamic programming, simulation, models, optimization, with applications to system design, economics, engineering and management. Three lecture hours per week. Prerequisites: MAT 308 and knowledge of a scientific programming language.

MAT 427 Statistical Experimental Design 3 credits
An overview of fundamental designs used to analyze experimental data. Topics include simple and multiple linear regression, analysis of variance, two-group discriminant analysis, factor analysis, time series analysis, and the analysis of categorical data. There will be extensive use of statistical software packages on the computer. Not open to students who have previously completed MAT 347. Three lecture hours per week. Prerequisites: MAT 247 or MAT 407.

MAT 500 Directed Study in Mathematics 3 credits
The purpose of this course is to provide the student with an opportunity to explore in depth an area of mathematics that would not ordinarily be encountered in the program of required courses. It is recommended that the student take as many of the required courses as possible before enrolling in Directed Study. Credits for this course may not be applied toward Major requirements. Prerequisites: At least one 400 level math course (with a grade of C or above), Junior or Senior standing, agreement of a Department faculty member to act as supervisor and permission of Mathematics Department Chairperson.

MAT 520 Mathematics Internship 3-12 credits
An opportunity for students to gain practical or technical training in an industrial/commercial/research environment. The student makes the necessary arrangements with the chosen facility, in consultation with an appropriate faculty member. The internship must meet College Academic Policies (described elsewhere in this Catalog) and Mathematics Department Policy (available in the Mathematics Department). Open only to Junior/Senior Mathematics majors who have obtained a faculty sponsor for this internship. Prerequisite: Permission of a faculty supervisor and permission of the Department Chairperson.

MAT 572 Mathematics Research I 3 credits
This course provides qualified students with research direction and the opportunity to participate in independent work in any area of mathematics of special interest to them, provided that a faculty supervisor is available. A paper and poster presentation is required at the end of the course. Open only to Junior/Senior Mathematics majors. Prerequisite: Permission of the faculty supervisor and the Department Chairperson.

MAT 573 Mathematics Research II 3 credits
This course builds on MAT 572, continuing with the same project or starting with a new project. Students in this course will be expected to present their results in a professional setting. Open only to Junior/Senior Mathematics majors. Prerequisite: Permission of the faculty supervisor and of the Department Chairperson.

EDUCATION

EDU 337M Secondary School Curriculum Materials and Methodology in Math (Prepracticum) 3 credits
This course culminates prepracticum courses required for certification in teaching math at the high school level. It prepares the student to effectively teach a modern math curriculum and emphasizes the philosophy and psychological foundations of math education. Current texts and materials are considered, as are strategies, the use of media including computer-assisted instruction, and the relationship of math to social issues. Three lecture hours and two hours of field work per week. Prerequisite: Permission of Math Department Chairperson.