499 Internship (1–3)
Community-based experience in a justice-related field at an approved site. Jointly sponsored by a faculty member and a representative from the sponsoring agency. Must be approved by the Justice Program Coordinator. A reflection paper appropriate to the nature of the internship will be required. Graded S/U.
The purpose of this requirement is to nurture the development of mathematical writing in order to deepen the student's understanding of mathematics and to enable the student to communicate technical ideas to a range of audiences. Sophomores are expected to demonstrate proficiency in expository mathematics by the submission of an acceptable portfolio. Juniors are expected to demonstrate proficiency in technical or analytical mathematical writing by the submission of an acceptable portfolio. Seniors demonstrate their ability by completing a senior comprehensive paper, which is evaluated by a committee of three faculty.

**SENIOR COMPREHENSIVE**
All mathematics majors, in Pro-Seminar (MATH 496), independently study a mathematical topic of their choice and work with a faculty advisor. They present their work in a series of talks in the seminar. The project culminates in a paper and a formal presentation. This final presentation, followed by questioning by a faculty committee, constitutes the Senior Comprehensive in mathematics.

**MATHEMATICS AND COMPUTER SCIENCE DEPARTMENT LEARNING OUTCOMES**
- The graduate will demonstrate depth and breadth of knowledge of mathematical concepts, methods, reasoning, and language.
- The graduate will be able to engage in independent learning, application, and problem solving.
- The graduate will be able to communicate her ideas and the results of her work, both orally and in writing, with clarity and precision.
- The graduate will recognize the importance of social and ethical issues in professional settings.
- The graduate will be prepared for a career path that requires mathematical understanding.
- The graduate will be prepared to be a contributing member of a problem solving team.
- The graduate will utilize appropriate technology for analysis and problem solving.
- The graduate will have developed an appreciation for the power and beauty of mathematics.

**Bachelor of Science: Major in Mathematics—MATH (60 hours)**

All of the following:
- MATH 131-132 Calculus I, II 8 hours
  - or MATH 133 Theory and Application of Calculus 4 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
- MATH 231 Calculus III 4 hours
- MATH 326 Linear Algebra and Differential Equations 4 hours
- MATH 496 Pro-Seminar 2 hours
- CPSC 207 Computer Programming 3 hours

**Two full-year sequences (one of which must be either Analysis or Algebra):**
- MATH 335-336 Differential Equations II & Numerical Analysis 6 hours
- MATH 341-342 Analysis I, II 6 hours
- MATH 345-346 Probability, Statistics 6 hours
- MATH 353-354 Abstract Algebra I, II 6 hours

**Additional mathematics, computer science, or science electives to bring the total to 60 hours if needed.**

**Bachelor of Arts: Major in Mathematics—MATH (38–42 hours)**

All of the following:
- MATH 131-132 Calculus I, II 8 hours
  - or MATH 133 Theory and Application of Calculus 4 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
- MATH 231 Calculus III 4 hours
- MATH 326 Linear Algebra and Differential Equations 4 hours
- MATH 496 Pro-Seminar 2 hours
- CPSC 207 Computer Programming 3 hours

**Two full-year sequences (one of which must be either Analysis or Algebra):**
- MATH 335-336 Differential Equations II & Numerical Analysis 6 hours
- MATH 341-342 Analysis I, II 6 hours
- MATH 345-346 Probability, Statistics 6 hours
- MATH 353-354 Abstract Algebra I, II 6 hours

**Six additional hours at the 300–400 level (above 302):**
- CPSC 315 Simulation: Theory and Application 3 hours
  - or CPSC 328 Data Structures 3 hours
- MATH 335 Differential Equations II 3 hours
- MATH 336 Numerical Analysis 3 hours
- MATH 339 Discrete Mathematics 3 hours
- MATH 341 Analysis I 3 hours
- MATH 342 Analysis II 3 hours
- MATH 345 Probability 3 hours
- MATH 346 Statistics 3 hours
- MATH 353 Abstract Algebra I 3 hours
- MATH 354 Abstract Algebra II 3 hours
- MATH 490 Special Topics 1–3 hours
- MATH 497 Independent Study 1–3 hours

At least 15 hours of science other than mathematics or computer science including one of the following full-year sequences:
- BIO 155-158 Foundations of Biology sequence 8 hours
- CHEM 121-122 Principles of Chemistry I, II 8 hours
- PHYS 121-122 General Physics I, II 8 hours

**Six additional hours at the 300–400 level (above 302):**
- CPSC 315 Simulation: Theory and Application 3 hours
  - or CPSC 328 Data Structures 3 hours
- MATH 335 Differential Equations II 3 hours
- MATH 336 Numerical Analysis 3 hours
- MATH 339 Discrete Mathematics 3 hours
- MATH 341 Analysis I 3 hours
- MATH 342 Analysis II 3 hours
- MATH 345 Probability 3 hours
- MATH 346 Statistics 3 hours
- MATH 353 Abstract Algebra I 3 hours
- MATH 354 Abstract Algebra II 3 hours
- MATH 490 Special Topics 1–3 hours
- MATH 497 Independent Study 1–3 hours

**Advanced writing proficiency**
The purpose of this requirement is to nurture the development of mathematical writing in order to deepen the student's understanding of mathematics and to enable the student to communicate technical ideas to a range of audiences. Sophomores are expected to demonstrate proficiency in expository mathematics by the submission of an acceptable portfolio. Juniors are expected to demonstrate proficiency in technical or analytical mathematical writing by the submission of an acceptable portfolio. Seniors demonstrate their ability by completing a senior comprehensive paper, which is evaluated by a committee of three faculty.

**Saint Mary's College**
Bachelor of Science: Major in Statistical and Actuarial Mathematics — SAM (60 hours)

All of the following:
MATH 131-132 Calculus I, II 8 hours
or MATH 133 Theory and Application of Calculus 4 hours
MATH 225 Foundations of Higher Mathematics 3 hours
MATH 231 Calculus III 4 hours
MATH 326 Linear Algebra and Differential Equations 4 hours
MATH 496 Pro-Seminar 2 hours
CPSC 207 Computer Programming 3 hours

All of the following:
MATH 252 Financial Mathematics 3 hours
MATH 345 Probability 3 hours
MATH 346 Statistics 3 hours
MATH 372 Stochastic Models 3 hours

One of the following full-year sequences:
MATH 341-342 Analysis I, II 6 hours
MATH 353-354 Abstract Algebra I, II 6 hours

Three additional hours at the 300-400 level (above 302):
CPSC 315 Simulation: Theory and Application 3 hours
or CPSC 328 Data Structures 3 hours
MATH 335 Differential Equations II 3 hours
MATH 339 Discrete Mathematics 3 hours
MATH 341 Analysis I 3 hours
MATH 342 Analysis II 3 hours
MATH 353 Abstract Algebra I 3 hours
MATH 354 Abstract Algebra II 3 hours
MATH 361 Geometry 3 hours
MATH 381 Mathematical Modeling 3 hours
MATH 438 Mathematical Programming 3 hours
MATH 490 Special Topics 1–3 hours
MATH 497 Independent Study 1–3 hours

Bachelor of Arts: Major in Statistical and Actuarial Mathematics—SAM (41–45 hours)

All of the following:
MATH 131-132 Calculus I, II 8 hours
or MATH 133 Theory and Application of Calculus 4 hours
MATH 225 Foundations of Higher Mathematics 3 hours
MATH 231 Calculus III 4 hours
MATH 326 Linear Algebra and Differential Equations 4 hours
MATH 496 Pro-Seminar 2 hours
CPSC 207 Computer Programming 3 hours

All of the following:
MATH 252 Financial Mathematics 3 hours
MATH 345 Probability 3 hours
MATH 346 Statistics 3 hours
MATH 372 Stochastic Models 3 hours

One of the following full-year sequences:
MATH 341-342 Analysis I, II 6 hours
MATH 353-354 Abstract Algebra I, II 6 hours

Three additional hours at the 300-400 level (above 302):
CPSC 315 Simulation: Theory and Application 3 hours
or CPSC 328 Data Structures 3 hours
MATH 335 Differential Equations II 3 hours
MATH 339 Discrete Mathematics 3 hours
MATH 341 Analysis I 3 hours
MATH 342 Analysis II 3 hours
MATH 353 Abstract Algebra I 3 hours
MATH 354 Abstract Algebra II 3 hours
MATH 361 Geometry 3 hours
MATH 381 Mathematical Modeling 3 hours
MATH 438 Mathematical Programming 3 hours
MATH 490 Special Topics 1–3 hours
MATH 497 Independent Study 1–3 hours

Recommended courses for students who plan to sit for the Actuarial exams:
BUAD 201 Principles of Financial Accounting 3 hours
BUAD 312 Principles of Finance 3 hours
BUAD 313 Investments 3 hours
ECON 251 Principles of Macroeconomics 3 hours
ECON 252 Principles of Microeconomics 3 hours

Bachelor of Science: Major in Computing and Applied Mathematics—CAM (59–64 hours)

All of the following:
MATH 131-132 Calculus I, II 8 hours
or MATH 133 Theory and Application of Calculus 4 hours
MATH 225 Foundations of Higher Mathematics 3 hours
MATH 231 Calculus III 4 hours
MATH 326 Linear Algebra and Differential Equations 4 hours
MATH 339 Discrete Mathematics 3 hours
MATH 496 Pro-Seminar 2 hours

Recommended courses for students who plan to sit for the Actuarial exams:
BUAD 201 Principles of Financial Accounting 3 hours
BUAD 312 Principles of Finance 3 hours
BUAD 313 Investments 3 hours
ECON 251 Principles of Macroeconomics 3 hours
ECON 252 Principles of Microeconomics 3 hours
<table>
<thead>
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<tr>
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<td>2</td>
</tr>
<tr>
<td>CPSC 328</td>
<td>Data Structures</td>
<td>3</td>
</tr>
</tbody>
</table>

**Three of the following:**

- MATH 335  Differential Equations II  3 hours
- MATH 336  Numerical Analysis         3 hours
- MATH 341  Analysis I                 3 hours
- MATH 342  Analysis II                3 hours
- MATH 345  Probability                3 hours
- MATH 346  Statistics                 3 hours
- MATH 353  Abstract Algebra I         3 hours
- MATH 354  Abstract Algebra II        3 hours
- MATH 361  Geometry                   3 hours
- MATH 381  Mathematical Modeling      3 hours
- MATH 438  Mathematical Programming   3 hours

At least 15 hours of science other than mathematics or computer science including one of the following full-year sequences:

- BIO 153-154 Foundations of Biology I, II 8 hours
- CHEM 121-122 Principles of Chemistry I, II 8 hours
- PHYS 121-122 General Physics I, II 8 hours

**Bachelor of Arts Major in Computing and Applied Mathematics—CAM (44–49 hours)**

**All of the following:**

- MATH 131-132 Calculus I, II 8 hours
  or MATH 133 Theory and Application of Calculus 4 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
- MATH 231 Calculus III 4 hours
- MATH 326 Linear Algebra and Differential Equations 4 hours
- MATH 339 Discrete Mathematics 3 hours
- MATH 496 Pro-Seminar 2 hours
- CPSC 207 Computer Programming 2 hours
- CPSC 328 Data Structures 3 hours

**Three of the following:**

- MATH 335  Differential Equations II 3 hours
- MATH 336  Numerical Analysis         3 hours
- MATH 341  Analysis I                 3 hours
- MATH 342  Analysis II                3 hours
- MATH 345  Probability                3 hours
- MATH 346  Statistics                 3 hours
- MATH 353  Abstract Algebra I         3 hours
- MATH 354  Abstract Algebra II        3 hours
- MATH 361  Geometry                   3 hours
- MATH 381  Mathematical Modeling      3 hours
- MATH 438  Mathematical Programming   3 hours

**Bachelor of Science: Major in Physics and Applied Mathematics—PAM (60 hours)**

**All of the following:**

- MATH 131-132 Calculus I, II 8 hours
  or MATH 133 Theory and Application of Calculus 4 hours
- CPSC 207 Computer Programming 3 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
- MATH 231 Calculus III 4 hours
- MATH 326 Linear Algebra and Differential Equations 4 hours
- MATH 496 Pro-Seminar 2 hours
- PHYS 121 General Physics I lab 4 hours
- PHYS 122 General Physics II lab 4 hours
- PHYS 253 General Physics III 3 hours

**One of the following:**

- PHYS 272L Computational Physics Laboratory lab 1 hour
- PHYS 282L Modern Experimental Laboratory lab 1 hour
- PHYS 292L Wave Mechanics Laboratory lab 1 hour

**Three physics electives from:**

- PHYS 215 Materials Science 3 hours
- PHYS 232 Astrophysics 3 hours
- PHYS 235 Nuclear Physics 3 hours
- PHYS 323 Classical Mechanics 3 hours
- PHYS 343 Thermodynamics 3 hours
- PHYS 424 Quantum Mechanics 3 hours
- PHYS 444 Electricity and Magnetism 3 hours

**Three mathematics and computer science electives from:**

- CPSC 315 Simulation: Theory and Application 3 hours
  or CPSC 328 Data Structures 4 hours
- MATH 335 Differential Equations II 3 hours
- MATH 336 Numerical Analysis 3 hours
- MATH 341 Analysis I 3 hours
- MATH 342 Analysis II 3 hours
- MATH 345 Probability 3 hours
- MATH 346 Statistics 3 hours
- MATH 353 Abstract Algebra I 3 hours
- MATH 354 Abstract Algebra II 3 hours
- MATH 381 Mathematical Modeling 3 hours

**Bachelor of Arts: Major in Physics and Applied Mathematics—PAM (50–54 hours)**

**All of the following:**

- CPSC 207 Computer Programming 3 hours
- MATH 131-132 Calculus I, II 8 hours
  or MATH 133 Theory and Application of Calculus 4 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
MATH 231  Calculus III    4 hours
MATH 326  Linear Algebra and Differential Equations   4 hours
MATH 496  Pro-Seminar    2 hours
PHYS 121  General Physics I lab 4 hours
PHYS 122  General Physics II lab 4 hours
PHYS 253  General Physics III lab 3 hours

One of the following:
PHYS 272L  Computational Physics Laboratory lab 1 hour
PHYS 282L  Modern Experimental Laboratory lab 1 hour

Three physics electives from:
PHYS 215  Materials Science 3 hours
PHYS 232  Astrophysics 3 hours
PHYS 235  Nuclear Physics 3 hours
PHYS 323  Classical Mechanics 3 hours
PHYS 343  Thermodynamics 3 hours
PHYS 424  Quantum Mechanics 3 hours
PHYS 444  Electricity and Magnetism 3 hours

Three mathematics and computer science electives from:
CPSC 315  Simulation: Theory and Application 3 hours
or CPSC 328  Data Structures 4 hours
MATH 335  Differential Equations II 3 hours
MATH 336  Numerical Analysis 3 hours
MATH 341  Analysis I 3 hours
MATH 342  Analysis II 3 hours
MATH 345  Probability 3 hours
MATH 346  Statistics 3 hours
MATH 353  Abstract Algebra I 3 hours
MATH 354  Abstract Algebra II 3 hours
MATH 381  Mathematical Modeling 3 hours

Bachelor of Science: Major in Mathematics, Teacher Concentration—
MATT (60 hours)

All of the following:
MATH 131-132  Calculus I, II 8 hours
or MATH 133  Theory and Application of Calculus 4 hours
MATH 225  Foundations of Higher Mathematics 3 hours
MATH 231  Calculus III 4 hours
MATH 326  Linear Algebra and Differential Equations 4 hours
MATH 496  Pro-Seminar 2 hours
CPSC 207  Computer Programming 3 hours

All of the following:
MATH 339  Discrete Mathematics 3 hours
MATH 345  Probability 3 hours
MATH 346  Statistics 3 hours
MATH 353  Abstract Algebra I 3 hours
MATH 361  Geometry 3 hours

One of the following:
MATH 341  Analysis I 3 hours
MATH 354  Abstract Algebra II 3 hours

At least 15 hours of science other than mathematics or computer science including one of the following full-year sequences:
BIO 155-158  Foundations of Biology sequence 8 hours
CHEM 121-122  Principles of Chemistry I, II 8 hours
PHYS 121-122  General Physics I, II 8 hours

Additional mathematics, computer science, or science electives to bring the total to 60 hours if needed.

Bachelor of Arts: Major in Mathematics, Teacher Concentration—MATC
(38–42 hours)

All of the following:
MATH 131-132  Calculus I, II 8 hours
or MATH 133  Theory and Application of Calculus 4 hours
MATH 225  Foundations of Higher Mathematics 3 hours
MATH 231  Calculus III 4 hours
MATH 326  Linear Algebra and Differential Equations 4 hours
MATH 496  Pro-Seminar 2 hours
CPSC 207  Computer Programming 3 hours

All of the following:
MATH 339  Discrete Mathematics 3 hours
MATH 345  Probability 3 hours
MATH 346  Statistics 3 hours
MATH 353  Abstract Algebra I 3 hours
MATH 361  Geometry 3 hours

One of the following:
MATH 341  Analysis I 3 hours
MATH 354  Abstract Algebra II 3 hours

Minor in Mathematics—MATH (15–19 hours)

One of the following:
MATH 105  Elements of Calculus I 3 hours
MATH 131  Calculus I 4 hours
MATH 133  Theory and Application of Calculus 4 hours

Two of the following:
MATH 108  Elements of Linear Algebra 3 hours
or MATH 326  Linear Algebra and Differential Equations 4 hours
MATH 114  Introduction to Statistics 3 hours
or MATH 345  Probability 3 hours
MATH 209  Introduction to Cryptology 3 hours
or MATH 211  Elementary Number Theory 3 hours
MATH 225  Foundations of Higher Mathematics 3 hours
MATH 251  Principles of Operations Research 3 hours
MATH 252  Financial Mathematics 3 hours
MATH 335  Differential Equations II 3 hours
or MATH 336  Numerical Analysis 3 hours
MATH 361  Geometry 3 hours
CPSC 207  Computer Programming 3 hours

Two of the following (MATH 104 allowed with departmental approval):
MATH 106  Elements of Calculus II 3 hours
MATH 108  Elements of Linear Algebra 3 hours
MATH 110  Modern Geometries 3 hours
MATH 114  Introduction to Statistics 3 hours
MATH 118  Patterns in Mathematics for Elementary Teachers 3 hours
MATH 132  Calculus II 3 hours
MATH 209  Introduction to Cryptology 3 hours
MATH 211  Elementary Number Theory 3 hours
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<td>Calculus III</td>
<td>4 hours</td>
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<td>MATH 241</td>
<td>Statistical Applications</td>
<td>3 hours</td>
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<td>Principles of Operations Research</td>
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<td>MATH 252</td>
<td>Financial Mathematics</td>
<td>3 hours</td>
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<td>MATH 272</td>
<td>Women in Mathematics: Seminar</td>
<td>3 hours</td>
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<td>MATH 282</td>
<td>Mathematics for Elementary School Teachers</td>
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<td>MATH 286</td>
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</tr>
<tr>
<td>MATH 438</td>
<td>Mathematical Programming</td>
<td>3 hours</td>
</tr>
</tbody>
</table>

**Minor in Mathematics/Computer Science — MTHC (21–25 hours)**

All of the following:
- CPSC 207 Computer Programming 3 hours

Two of the following:
- CPSC 307 C and Assembly Language Programming 3 hours
- CPSC 308 Electronic Communications 3 hours
- CPSC 315 Simulation: Theory and Application 3 hours
- CPSC 328 Data Structures 3 hours
- CPSC 417 Systems Analysis and Design 4 hours
- CPSC 429 Database Systems 3 hours

One of the following:
- MATH 105 Elements of Calculus I 3 hours
- MATH 131 Calculus I 4 hours
- MATH 133 Theory and Application of Calculus 4 hours

Two of the following:
- MATH 108 Elements of Linear Algebra 3 hours
  or MATH 326 Linear Algebra and Differential Equations 4 hours
- MATH 114 Introduction to Statistics 3 hours
  or MATH 345 Probability 3 hours
- MATH 209 Introduction to Cryptology 3 hours
  or MATH 211 Elementary Number Theory 3 hours
- MATH 225 Foundations of Higher Mathematics 3 hours
- MATH 251 Principles of Operations Research 3 hours
- MATH 252 Financial Mathematics 3 hours
- MATH 335 Differential Equations II 3 hours
  or MATH 336 Numerical Analysis 3 hours
- MATH 361 Geometry 3 hours

One of the following:
- MATH 106 Elements of Calculus II 3 hours
- MATH 108 Elements of Linear Algebra 3 hours
- MATH 110 Modern Geometries 3 hours

**MATHEMATICS COURSES (MATH)**

**100 Problem-Solving Strategies in Mathematics (3)**
Intensive study of the problem-solving process. Algebraic, patterning, modeling, and geometric strategies are explored. Includes a review of basic algebra skills and concepts necessary for problem solving. Consent of the Department is required. This does not fulfill the Mathematical Arts requirement of the Sophia Program.

**102 Liberal Arts Mathematics (3)**
Mathematical modeling through the use of graph theory. Topics include graphs, directed graphs, trees, matchings and network flows. Designed primarily for first year college students. Prerequisite: MATH 100 or recommendation of Math Placement Advisor.

**103 Precalculus (3)**
This course studies polynomial, rational, exponential, logarithmic, and trigonometric functions from the symbolic, numeric, and graphical perspectives. The emphasis on these concepts will provide solid preparation for a college-level calculus course. This does not fulfill the Mathematical Arts requirement of the Sophia Program. Prerequisite: MATH 102 or recommendation of Math Placement Advisor.

**104 Finite Mathematics (3)**
Set theory, counting techniques, probability, random variables, expected value, variance, standard deviation, and linear programming. Prerequisite: MATH 103 or recommendation of Math Placement Advisor.
105–106 Elements of Calculus I, II (3, 3)
Introduction to differential and integral calculus designed primarily for liberal arts students and those in the professional programs. Limits are treated intuitively. Emphasis on applications. MATH 105 is prerequisite for MATH 106.

107 Mathematics for Sustainability (3)
This course develops and applies mathematical concepts and tools to quantitatively explore sustainability issues. Topics such as industrial agriculture, energy sustainability, population growth, and ecological footprints will be explored from environmental, social, and economic perspectives wherever possible. Mathematical concepts developed in the course are motivated through the study of these topics and allow students to survey several mathematical areas. Particular concepts covered include properties of real numbers, algebraic simplification of expressions, solving equations and inequalities, rates of change, interpretation of numerical information, functions and inverses, modeling, differentiation/integration, qualitative analysis of differential equation models, calculating probabilities, statistical techniques on real data, and graph paths and connectivity.

108 Elements of Linear Algebra (3)
Matrices, systems of equations, determinants, eigenvalues, linear transformations, vector spaces. Emphasis on applications. Prerequisite: MATH 104 or 105.

110 Modern Geometries (3)
Finite geometries; Transformational geometry with an introduction to fractals; Euclidean geometry, including classical constructions; Non-Euclidean geometries, including hyperbolic and/or projective geometry. Prerequisite: MATH 104 or 105.

114 Introduction to Statistics (3)
Introduction to basic sampling and experimental design. Basics of probability, random variables, and probability distributions. Sampling distributions. Estimation and hypothesis testing for means and proportions. Statistical software will be used. Prerequisite: MATH 104 or 105 or equivalent.

118 Patterns in Mathematics for Elementary Teachers (3)
Problem solving and strategies; properties of whole numbers, integers, rational numbers, and real numbers; algorithms and computation; elementary number theory. The course follows the recommendations of the Mathematical Association of America and the National Council of Teachers of Mathematics for the training of elementary teachers. Prerequisite: One Mathematical Arts Sophia Program course.

131–132 Calculus I, II (4, 4)
Algebraic and transcendental functions; limits; continuity; derivatives; maxima and minima; concavity; related rates; Taylor polynomials; Mean Value Theorem; anti-differentiation; Riemann sums; Fundamental Theorem of Calculus; techniques of integration; sequences and series. The course is based on graphical, numerical, and symbolic points of view. Graphing calculators are used throughout the course. Prerequisite: At least four years of high school mathematics. MATH 131 is a prerequisite for MATH 132.

133 Theory and Application of Calculus (4)
This course is designed for students who have completed a full year of calculus in high school and have mastered the mechanics of differentiation and integration. The basic concepts of a two-semester college calculus sequence, including limits, derivates, integrals, sequences and series, will be explored in depth. The emphasis of the course is on understanding the theory of calculus and constructing mathematical models. Prerequisite: A minimum score of 3 on the AP Calculus exam or permission of instructor.

180 Mathematics of Voting (1)
This course builds on mathematical ideas from number theory, probability and linear algebra. The course studies various ciphers such as Hill, Vigenere, RSA, DES. Prerequisite: Either MATH 105, 118, or 131.

209 Introduction to Cryptology (3)
This course builds on mathematical ideas from number theory, probability, and linear algebra. The course studies various ciphers such as Hill, Vigenere, RSA, DES. Prerequisite: Either MATH 105, 118, or 131.

211 Elementary Number Theory (3)
Basic number theoretic concepts are studied, with an emphasis on writing proofs. Divisibility; primes; Euclid’s algorithm and its consequences; linear diophantine equations; residue classes; linear congruences; arithmetic functions. Applications of number theory to computer science (cryptography, complexity of computations). Prerequisite: MATH 118 or 131.

225 Foundations of Higher Mathematics (3)
Set theory, logic, relations, functions, and an introduction to abstract mathematical structures, with an emphasis on reading and writing mathematical proofs. Prerequisite: one calculus course or permission of instructor.

231 Calculus III (4)

241 Statistical Applications (3)
Sampling studies, design of experiments, hypothesis testing, analysis of variance, regression and correlation, regression modeling, time series. Introduction to operations research: queuing, systems analysis, quality assurance, acceptance sampling. Emphasis on applications to business and economic decision making. MATH 241 is also listed as BUAD 341. Prerequisite: MATH 114 with a grade of “C” or higher.

251 Principles of Operations Research (3)
An introduction to Operations Research—quantitative models used in management decision-making. The course will focus on the models as tools with computer software used extensively for problem solving and assignments. Case studies are used. MATH 251 is also listed as BUAD 427. Prerequisite: One year of Calculus or MATH 114.

252 Financial Mathematics (3)
Mathematical theory of interest, annuities, amortization schedules, yield rates, and sinking funds. Prerequisite: Two semesters of calculus or equivalent or permission of the instructor.

272 Women and Mathematics: Seminar (3)
This course has three major components: an overview of the history of mathematics, the lives and contributions of selected women mathematicians throughout history, and the experiences of women in the contemporary mathematical community. In our general exploration of history, we focus on the development of mathematical ideas and the contributions made by various cultures and individuals. Among the historical figures studied in depth are Hypatia, Maria Agnesi, Sophie Germain, Sofia Kovalevskaia, Emmy Noether, Julia Robinson. The course will examine the ways in which the views of the modern mathematical community and the broader society discourage or encourage the participation of women and other under-represented groups in mathematics. Prerequisite: One semester of college-level calculus or equivalent.

302 Mathematics for Elementary School Teachers (3)
Review of basic properties of the real number system. Foundations of Euclidean geometry with additional study of transformational geometry. Elementary probability and statistics. This course meets for two hours of class instruction and has a two-hour laboratory component. Recommendations of MAA and NCTM are continued. Prerequisite: Two MATH courses including MATH 118 with a grade of C or higher in MATH 118.

326 Linear Algebra and Differential Equations (4)
Linear systems; linear independence; matrix algebra; determinants; vector spaces including subspaces, dimension, rank, change of bases; linear transformations; eigenvalues and eigenvectors; inner product; orthogonality; and Gram-Schmidt. An introduction to differential equations, including first order linear, separable, and exact; second order with constant coefficients and variation of parameters; reduction of order, and undetermined coefficients. Applications included. Prerequisites: MATH 231.

335 Differential Equations II (3)
A study of methods for solving higher order linear ordinary differential equations, linear first order systems, and boundary value problems for the heat and wave equations. Analysis of boundary value problems for linear systems of first order ordinary differential equations using approximation by linear systems, numerical solutions and...
phase portraits. The course will use mathematical software to solve differential equations and systems of
differential equations symbolically, numerically and graphically. Prerequisite: MATH 326.

**336 Numerical Analysis (3)**
linear algebra. Numerical solutions to ordinary differential equations. Numerical differentiation and
integration. Error analysis. Prerequisite or corequisite: MATH 326.

**339 Discrete Mathematics (3)**
Introduction to graph theoretic and combinatoric models: planar graphs; circuits; spanning trees;
network flows; counting; generating functions; recurrence relations. Prerequisites: MATH 225 and
CPSC 207.

**341–342 Analysis I, II (3, 3)**
Construction of the reals; Sequences; Real valued functions of a single real variable: continuity, uniform
continuity, sequences and series of functions, uniform convergence, differentiation, integration.
Prerequisites: MATH 225 and 231. MATH 341 is a prerequisite for MATH 342.

**345 Probability (3)**
A calculus-based approach to probability theory. Topics include probability spaces, classical theory,
random variables, discrete and continuous distributions, multivariate distributions, transformations
of random variables, random sampling, the law of large numbers, the central limit theorem and
moment generating functions. Prerequisite: MATH 231 or equivalent.

**346 Statistics (3)**
Topics include sampling distributions, estimation, theory of estimators, test of hypotheses, analysis of
variance, regression and correlation analysis, time series, experimental design, modeling and decision criteria.
The use of statistical analysis in decision problems is stressed. Prerequisite: MATH 345 or equivalent.

**349 Topics in Actuarial Mathematics II (2)**
A structured and collaborative approach to preparing for the Financial Mathematics actuarial exam.
In a particular, a review of the fundamental concepts of financial mathematics, and how those
concepts are applied in calculating present and accumulated values for various streams of cash flows.
Also an introduction to financial instruments, including derivatives and the concept of no-arbitrage.
Prerequisite: MATH 252.

**353–354 Abstract Algebra I, II (3, 3)**
Basic algebraic systems: groups, rings, and fields. Homomorphisms and factor groups, rings. Polynomial
rings and field extensions. Applications, including symmetry groups and algebraic coding theory.
Prerequisite: MATH 225 and 326. MATH 353 is a prerequisite for MATH 354.

**361 Geometry (3)**
Historical and formal development of Euclidean and non-Euclidean geometries; role of axiom systems;
congruence, parallelism, measurement. Prerequisite: MATH 225.

**372 Stochastic Models (3)**
Stochastic models of contingent payment, survival, frequency, severity and ruin. Compound
distribution models. Emphasis on application to actuarial models. Prerequisite: MATH 345.

**381 Mathematical Modeling (3)**
In this course, students study the modeling process with application from difference equations,
probability, dynamical systems, optimization, and simulation. Students will design, develop, implement,
evaluate, and present mathematical models using real data for observable phenomena. Models and
issues related to environmental and sustainability studies are emphasized. Prerequisites: MATH 326
and 345.

**438 Mathematical Programming (3)**
Topics include model building; classical optimization; linear programming; non-linear programming.
Prerequisite: MATH 231, MATH 326 and junior or senior status.