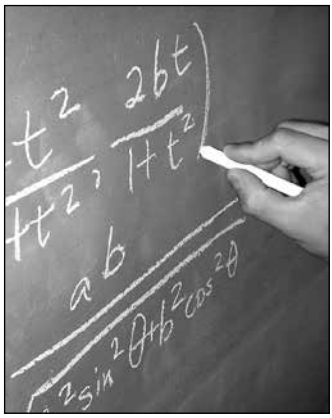

Mathematics and Computer Science

Colleen Hoover, Department Chair
334 Madeleva Hall
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PROGRAM IN MATHEMATICS

FACULTY

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DEPARTMENT DESCRIPTION

The study of mathematics has occupied humans from ancient times to the present. It is an intellectual process requiring creativity, analysis, logic, decision-making, synthesis of ideas, and communication. Mathematics exists in and for itself but also provides the technical basis for problem-solving in a wide variety of fields. The Saint Mary's graduate equipped with a strong mathematical background will be in the enviable position of being able to utilize her expertise in areas where rigorous thought and precision of results are necessary.

The courses in mathematics are offered for those studying the subject as part of a liberal education; for majors as a preparation for graduate studies, careers in business, or industry; and for those who intend to teach mathematics. In addition to the Major in Mathematics, we offer four tracks for those with special interests. The Statistics and Actuarial Mathematics Major is a sequence of courses giving the student experience in statistics with an emphasis on risk modeling and is recognized by the Society of Actuaries as a pre-actuarial program. The Computing and Applied Mathematics Major enables those students with a strong interest in computer science to pursue an integrated program of mathematics and computer science. Similarly, the Physics and Applied Mathematics Major enables those students with interests in physics and mathematics to pursue both. The Mathematics Major with Teacher Concentration enables the student to obtain secondary school certification in the State of Indiana.

TEACHER PREPARATION

The Department encourages students to prepare for teaching on all levels. Through the Teacher Concentration, courses are provided which enable mathematics majors to fulfill Indiana secondary teaching certification requirements. Students interested in secondary teaching are counseled within the Department to add professional education courses to their mathematics major program. Elementary education students may take courses leading to a mathematics minor or a double major in mathematics and elementary education.

4+1 in DATA SCIENCE

Any of the majors in mathematics and computer science can be combined with the Masters of Science in Data Science so that a student can complete the requirements for her

undergraduate degree and the M.S. in Data Science in five years. Interested students should consult the director of the Data Science Program to develop a five-year plan.

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.

SENIOR COMPREHENSIVE

All mathematics majors, in Pro-Seminar (MATH 496), study independently 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

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 361	Geometry	3 hours
MATH 362	Topology	3 hours
MATH 372	Stochastic Models	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

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—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 361	Geometry	3 hours

MATH 362	Topology	3 hours
MATH 372	Stochastic Models	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 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 336	Numerical Analysis	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 362	Topology	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

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.

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 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 336	Numerical Analysis	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 362	Topology	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 496	Pro-Seminar	2 hours
CPSC 207	Computer Programming	3 hours

Four of the following:

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 361	Geometry	3 hours
MATH 362	Topology	3 hours
MATH 381	Mathematical Modeling	3 hours
MATH 438	Mathematical Programming	3 hours

Four of the following:

CPSC 307	C and Assembly Language	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

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 496	Pro-Seminar	2 hours
CPSC 207	Computer Programming	3 hours

Four of the following:

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 361	Geometry	3 hours
MATH 362	Topology	3 hours
MATH 381	Mathematical Modeling	3 hours
MATH 438	Mathematical Programming	3 hours

Four of the following:

CPSC 307	C and Assembly Language	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

Bachelor of Science: Major in Physics and Applied Mathematics—PAM (60 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 312	Modern Physics		3 hours
PHYS 333	Mathematical Methods		3 hours

Two of the following:

PHYS 311	Thermodynamics	3 hours
PHYS 313	Classical Mechanics	3 hours
PHYS 424	Quantum Mechanics	3 hours
PHYS 444	Electricity and Magnetism	3 hours

Three of the following:

CPSC 315	Simulation: Theory and Application	3 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
MATH 438	Mathematical Programming	3 hours

Additional courses in science, mathematics, or computer science to bring the total to 60 hours.

Bachelor of Arts: Major in Physics and Applied Mathematics—PAM (49–53 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 312	Modern Physics		3 hours
PHYS 333	Mathematical Methods		3 hours

Two of the following:

PHYS 311	Thermodynamics	3 hours
PHYS 313	Classical Mechanics	3 hours
PHYS 424	Quantum Mechanics	3 hours
PHYS 444	Electricity and Magnetism	3 hours

Three of the following:

CPSC 315	Simulation: Theory and Application	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 381	Mathematical Modeling	3 hours
MATH 438	Mathematical Programming	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	4 hours
MATH 209	Introduction to Cryptology	3 hours
MATH 211	Elementary Number Theory	3 hours
MATH 225	Foundations of Higher Mathematics	3 hours
MATH 231	Calculus III	4 hours
MATH 241	Statistical Applications	3 hours
MATH 251	Principles of Operations Research	3 hours
MATH 252	Financial Mathematics	3 hours
MATH 272	Women in Mathematics: Seminar	3 hours
MATH 302	Mathematics for Elementary School Teachers	3 hours
MATH 326	Linear Algebra and Differential Equations	4 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 361	Geometry	3 hours
MATH 362	Topology	3 hours
MATH 372	Stochastic Models	3 hours
MATH 381	Mathematical Modeling	3 hours
MATH 438	Mathematical Programming	3 hours

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
MATH 114	Introduction to Statistics	3 hours
MATH 118	Patterns in Mathematics for Elementary Teachers	3 hours
MATH 132	Calculus II	4 hours
MATH 209	Introduction to Cryptology	3 hours
MATH 211	Elementary Number Theory	3 hours
MATH 225	Foundations of Higher Mathematics	3 hours
MATH 231	Calculus III	4 hours
MATH 241	Statistical Applications	3 hours
MATH 251	Principles of Operations Research	3 hours
MATH 252	Financial Mathematics	3 hours
MATH 272	Women in Mathematics: Seminar	3 hours
MATH 302	Mathematics for Elementary School Teachers	3 hours
MATH 326	Linear Algebra and Differential Equations	4 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 361	Geometry	3 hours
MATH 362	Topology	3 hours
MATH 372	Stochastic Models	3 hours
MATH 381	Mathematical Modeling	3 hours
MATH 438	Mathematical Programming	3 hours
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

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.

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.

104 Finite Mathematics (3)

Set theory, counting techniques, probability, random variables, expected value, variance, standard deviation, and linear programming.

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; the 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, derivatives, 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 in applied math and politics will focus on the mathematics behind voting in both two-party and multi-party systems, comparing systems in the US with those in France and Ireland. Students will explore both implemented and theoretical social choice functions and analyze each, subject to standard criteria. They will develop an understanding for how formal rules and procedures have an impact on policy outcomes and informal institutions such as political parties.

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)
Three-dimensional space: parametric equations, lines, planes, vectors, dot product, cross product. Polar coordinates. Vector-valued functions. Functions of several variables: partial derivatives, linear approximation, gradient, directional derivatives, maxima, minima, chain rule. Multiple integrals. Vector Calculus (including Green's Theorem and Stokes' Theorem). Prerequisite: MATH 132 or MATH 133.

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 Kovaleskaia, 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 nonlinear 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)
Computer arithmetic and algorithm convergence. Solutions of equations, polynomial interpolation, numerical differentiation and integration. Ordinary differential equations, numerical approximations of solutions to initial value problems. Error analysis. Prerequisite: MATH 132 or MATH 133. 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, multivariant 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.

362 Topology (3)
Basic concepts of point set topology, including separation axioms, connectedness, compactness and continuous mapping. Prerequisite: MATH 231.

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.

490 Special Topics (1–3)
Topics in Mathematics not covered in the regular department offerings. May be repeated for credit with a different topic.

496 Pro-Seminar (2)
Student presentation of selected topics. Prerequisite: Permission of the department chair.

497 Independent Study (1–3)
Provides properly qualified students with an opportunity for independent study and careful consideration from an advanced standpoint of selected topics in undergraduate mathematics. Prerequisite: Permission of the department chair.

499 Internship in Mathematics (1–3)
Professional work experience in mathematics or statistics with a business or organization.