Mathematics and Computer Science

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Degree Plans Offered in Mathematics and Computer Science
Major in Mathematics
Minor in Mathematics
Major in Computer Science
Minor in Computer Science

MATHEMATICS

The mission of the mathematics program is to provide diverse opportunities for the expansion of mathematical knowledge for majors and minors, for students in the physical and social sciences, for general students, and also for recent graduates as they pursue advanced study and jobs in industry.

A major in mathematics consists of:

Core Requirements (2 courses)
_____ MATH 251 Linear Algebra
_____ MATH 252 Calculus III

Upper Level Requirements (5 courses)
_____ MATH 301 Ordinary Differential Equations
_____ MATH 319 Euclidean Geometry, ancient through modern
_____ MATH 321 Numerical Analysis
_____ MATH 373 Knot Theory
_____ MATH 381 Applied Analysis
_____ MATH 385 Probability Theory
_____ MATH 401 Mathematical Biology
_____ MATH 409 Survey of Geometry
_____ MATH 419 Differential Geometry
_____ MATH 450 Advanced Topics in Mathematics
_____ MATH 472 Modern Algebra
_____ MATH 473 Topology
_____ MATH 474 Number Theory
_____ MATH 475 Mathematics of Finance
_____ MATH 482 Real Analysis
_____ MATH 483 Complex Analysis

Electives (1 course)
_____ MATH course – any level

Support Requirements for the Major
_____ CS course excluding CS 201

Other Considerations When Planning for the Major:

- Those who choose to major in mathematics must take all courses required for the major under the "standard letter grade" option.
- Students planning to major in mathematics are expected to enter directly into the calculus sequence beginning with Mathematics 151 or 152.

Total Credits Requirement = 8 course credits

A minor in mathematics consists of:

Core Requirements (2 courses)
_____ MATH 251 Linear Algebra
_____ MATH 252 Calculus III

Upper Level Requirements (2 courses)
_____ MATH 301 Ordinary Differential Equations
_____ MATH 319 Euclidean Geometry, ancient through modern
_____ MATH 321 Numerical Analysis
_____ MATH 373 Knot Theory
_____ MATH 381 Applied Analysis
_____ MATH 385 Probability Theory
_____ MATH 401 Mathematical Biology
_____ MATH 409 Survey of Geometry
_____ MATH 419 Differential Geometry
_____ MATH 450 Advanced Topics in Mathematics
_____ MATH 472 Modern Algebra
_____ MATH 473 Topology
_____ MATH 474 Number Theory
_____ MATH 475 Mathematics of Finance
_____ MATH 482 Real Analysis
_____ MATH 483 Complex Analysis

Electives (1 course)
_____ MATH course – any level

Other Considerations When Planning for the Minor:
- Those who choose to minor in mathematics must take all courses required for the minor under the "standard letter grade" option.
- Students planning to major in mathematics are expected to enter directly into the calculus sequence beginning with Mathematics 151 or 152.

Total Credits Requirement = 5 course credits

COMPUTER SCIENCE
The computer science curriculum introduces students to theoretical and practical aspects of computing. The mission of the computer science program is to provide an environment in which students can prepare themselves for careers and further study in computer science, and to introduce students to concepts and skills in computer science relevant to a liberal arts education. Since computer science and computer technology are undergoing rapid change, the program must prepare students for immediate success and for continued success in the future. The curriculum addresses applications in a variety of programming languages on current platforms.

A **major in computer science** consists of:

Computer Science Major Core Requirements* (3 courses)

_____ CS 201 Discrete Mathematics
_____ CS 211 Fundamental Data Structures, Algorithms, and Applications
_____ CS 221 Computer Systems and Foundations
* Majors must earn C or better in each of these courses.

Computer Science Major Upper Level Requirements (2 courses)

_____ CS 321 Computer Networks & Security
_____ CS 330 Database Systems
_____ CS 380 Software Engineering
_____ CS 410 Programming Languages
_____ CS 412 Data Structures and Algorithms
_____ CS 420 Operating Systems
_____ CS 440 Artificial Intelligence
_____ CS 441 Machine Learning
_____ CS 350, 450 Advanced Topics in Computer Science
_____ CS 451 Computer Graphics
_____ CS 460 Advanced Directed Study
_____ CS 470 Theoretical Foundations of Computer Science

Computer Science Major Advanced Requirements (1 course)

_____ CS 410 Programming Languages
_____ CS 412 Data Structures and Algorithms
_____ CS 420 Operating Systems
_____ CS 440 Artificial Intelligence
_____ CS 441 Machine Learning
_____ CS 450 Advanced Topics in Computer Science
_____ CS 451 Computer Graphics
_____ CS 460 Advanced Directed Study
_____ CS 470 Theoretical Foundations of Computer Science

Computer Science Major Electives (2 courses)

_____ CS course - any level
_____ CS course - any level

Computer Science Major Support Requirements: All majors must also complete all of the following courses.

_____ MATH 120 Elementary Statistics
_____ MATH 151 Calculus I

Other Considerations When Planning for the Major:

- Courses used to meet the computer science major requirements must be completed using the standard letter grade system.

Total Credits Requirement = 8 course credits

A minor in computer science consists of:

Computer Science Minor Core Requirements* (3 courses)

_____ CS 201 Discrete Mathematics
_____ CS 211 Fundamental Data Structures, Algorithms, and Applications
_____ CS 221 Computer Systems and Foundations
* Majors must earn C or better in each of these courses.

Computer Science Minor Upper Level Requirements (1 course)

_____ CS 321 Computer Networks & Security
_____ CS 330 Database Systems
_____ CS 380 Software Engineering
_____ CS 410 Programming Languages
_____ CS 412 Data Structures and Algorithms
_____ CS 420 Operating Systems
_____ CS 440 Artificial Intelligence
_____ CS 441 Machine Learning
_____ CS 350, 450 Advanced Topics in Computer Science
_____ CS 451 Computer Graphics
_____ CS 460 Advanced Directed Study
_____ CS 470 Theoretical Foundations of Computer Science

Computer Science Minor Electives (1 course)

_____ CS course - any level

Other Considerations When Planning for the Minor:

- Courses used to meet the computer science minor requirements must be completed using the standard letter grade system.

Total Credits Requirement = 5 course credits

COURSES IN COMPUTER SCIENCE

CS 110 Introduction to Computer Science
A study of algorithm design, implementation, analysis, and application. Introduction to object-oriented programming including design, testing, and documentation. Introduction to computer architecture, data representation, and software engineering. Introduction to the Java programming language. Requirements met: Quantitative Competency (pre-Fall 2019). (Each fall and spring)

CS 111 Introduction to Scripting and Data Analytics with Python
A study of the Python programming language and how it is used to acquire, prepare, transform, analyze, and visualize data from a variety of sources including social science, humanities, and science domains. Students will learn the basics of Python scripting as well as common data analytics libraries. Recommended for any student wanting to learn how to manipulate and visualize data in their area of interest. Requirements met: Quantitative Competency (pre-Fall 2019). Cross-listed with Data Science and Analytics 111. (Each spring)

CS 120 Intermediate Computer Programming
A continuation of principles of program design and testing presented in CS 110; study of simple data structures (stacks, queues, lists, and trees) and their object-oriented implementations; object-oriented design patterns; graphical user interfaces; software engineering principles; unit testing and mock objects. PREQ: Computer Science 110 with a grade of C or better or instructor permission. Requirements met: Quantitative Competency (pre-Fall 2019). (Each fall and spring)

CS 201 Discrete Mathematics
An introduction to sets, relations, functions, graph theory, Boolean algebras, combinatorics, probability, conditional probability, random variables, logic and logic circuits. This course is required for advanced study in computer science. Requirements met: Quantitative Competency (pre-Fall 2019) and Advanced Writing Competency. (Each spring).

CS 211 Fundamental Data Structures, Algorithms, and Applications
A survey of the fundamental topics relating to the design and development of contemporary software applications. Topics include essential algorithms, modeling and complexity, knowledge representation, data structures, search strategies, automated reasoning, and artificial intelligence and database systems. This course is required for advanced study in computer science. PREQ: Computer Science 120 with a grade of C or better or instructor permission. (Each spring) A survey of the fundamental topics relating to the design and development of contemporary software systems. Topics include essential algorithms, computational modeling and complexity, knowledge representation and data structures, search strategies, automated reasoning, and theoretical computational models. This course is required for advanced study in computer science. PREQ: Computer Science 120 with a grade of C or better or instructor permission. (Each fall)

CS 221 Computer Systems and Foundations
A survey of fundamental topics regarding the foundations of computer science and the management of computer systems. Topics include introductions to computer design and organization, theory of computation, operating systems, and computer networking. This course is required for advanced study in computer science. PREQ: Computer Science 120 with a grade of C or better or instructor permission. Requirements met: Quantitative Competency (pre-Fall 2019). (Each spring)

CS 250 Topics in Computer Science
A study of selected topics for beginning students offered on an occasional basis. May be repeated when topic varies. Recent topics have included mobile app development.

CS 260 Intermediate Directed Study
Student investigation of topic of interest working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Freshman January term or Sophomore standing. Special permission required. Offered in variable course credit from 0.25-1.00.

CS 290 Practicum (Variable course credit)
A series of projects intended to provide students practice with a programming language such as C++, C, Swift, Haskell, Python, Mathlab, and others. May be repeated when language/topic varies. PREQ: Computer Science 120 with a grade of C or better or instructor permission.

CS 294 Intermediate Student Research
Intended for less experienced students to develop and execute a research project related to computer science, beyond the constraints of the normal classroom, suitable for public dissemination on or off campus under mentorship of a faculty member. Typically, this work results in a formal presentation, written work, or creative works. Course credit varies from 0-1.00. PREQ: Instructor permission required.

CS 321 Computer Networks & Security
An in-depth study of computer networking including the following topics: architecture principles (protocols, topologies, layered organizations, interfaces), networking technologies (Ethernet, Wi-Fi, FDDI, ATM), internetworking issues (addressing, routing, and sub-netting), end-to-end issues (data representation, compression, encryption), inter-process communication, network performance analysis, security issues, and high-speed networking alternatives. Emphasis will be given to internetworking with TCP/IP. PREQ: Computer Science 211 or Computer Science 221 with a grade of C or better. (Every other year – fall 2021)

CS 330 Database Systems
A system level study of bulk storage devices and data storage schemes; database management systems survey; EER/OO modeling; SQL, logical and physical database analysis, design, and implementation; relational and object-oriented database models; client/server architectures; small projects. PREQ: Computer Science 211 with a grade of C or better. (Every spring)

CS 350/450 Advanced Topics in Computer Science
Specialized topics for advanced study. Recent topics have included mobile app development and quantitative consulting. PREQ: Instructor permission. May be repeated when topic varies.

CS 360/460 Advanced Directed Study
Student investigation of topic of interest related to the major or minor working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered for variable course credit from 0.25-1.00.

CS 380 Software Engineering
A study of the software development life cycle including the analysis, specification, design, implementation and testing of software systems; management of software development projects. Includes classical and agile approaches. PREQ: Computer Science 120 with a grade of C or better. Requirements met: Advanced Writing Competency and Applied Learning Experience. (Every other year – spring 2020)

CS 394/494 Advanced Student Research
Intended for advanced students to develop and execute a research project related to computer science suitable for public dissemination under mentorship of a faculty member. Students are expected to present the results of their research in a public forum. Typically, this work results in a formal presentation, written work, or creative works. Course credit varies from 0-1.00. PREQ: Instructor permission required.

CS 410 Programming Languages
An in-depth study of the design and implementation of high-level programming languages. Languages from a variety of programming paradigms are presented including imperative, functional, and object-oriented languages. Formal approaches to defining syntax and semantics are used to describe the underlying concepts. Essential features of modern programming languages are discussed including control structures, scope rules, data types and validation, abstraction, exception handling, event handling, interpretation, and compilation. Hands-on experience with several programming languages will serve to solidify the concepts presented in lecture. PREQ: Computer Science 211 or Computer Science 221 with a grade of C or better. (Every other year)

CS 412 Data Structures and Algorithms
A study of intermediate to advanced data structures (linear structures, nonlinear structures, balanced trees and variants, graphs, heaps, and others) and their associated algorithms, analysis, and selection criteria; introduction to algorithm techniques (divide-and-conquer, dynamic programming, greedy algorithms, and others). PREQ: Computer Science 211 and Computer Science 201 with a grade of C or better. (Every other year)

CS 420 Operating Systems
Modular and layered design of operating systems including control of concurrent processes, synchronization and communication mechanisms, interrupt handling, resource management, scheduling, protection and reliability; memory systems, organization and management (including virtual memory); I/O systems, secondary storage, and file systems; the study of operating system utilities such as assemblers, linkers, loaders, language and command processors. PREQ: Computer Science 221 with a grade of C or better. (Every other year)

CS 440 Artificial Intelligence
Topics may include knowledge representation schemes, propositional and first-order predicate logic, search strategies, planning, neural nets and topics in machine learning, natural language processing, and other applications. PREQ: Computer Science 211 with a grade of C or better. (Every other year)

CS 441 Machine Learning
A study of machine learning algorithms including supervised, unsupervised, reinforcement learning, neural networks, predictive analytics, natural language processing, and other applications. PREQ: Math 120 (or equivalent), Math 151, and one of the following combinations of classes: (i) Computer Science 211 (grade of C or better) and Computer Science 290 (Python); (ii) Computer Science 211 (grade of C or better) and Computer Science 111/ Data Science and Analytics 111; or (iii) Data Science and Analytics 241. (Every other year)

CS 451 Computer Graphics
A study of 2D and 3D graphics and geometric modeling; transformations; clipping and windowing; scan-conversion techniques; representations of curves, surfaces and solids; wire frames, octrees, meshes; introduction to animation, color, shading, and ray tracing methods. PREQ: Computer Science 211 with a grade of C or better and one semester of C++ programming (CS 290). MATH 251 is recommended. (Every other year)

CS 464 Teacher/Learning Participation
An individualized study that includes sharing in the instructional process for a particular computer science course under the supervision of the faculty member teaching the course. Open only to certain highly qualified juniors and seniors by invitation. See On-Campus Learning Opportunities for more information.

CS 470 Theoretical Foundations of Computer Science
Topics include finite state automata, push-down automata, Turing machines, formal grammars, the Chomsky hierarchy, complexity, computability, programming language translation. PREQ: Computer Science 201 with a grade of C or better. (Every other year)

CS 490 Independent Study
Student-driven independent work to produce a high quality body of work such as paper, report, art project, etc. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.

CS 491 Honors Thesis in Computer Science
Extensive independent study in the major in a topic of special interest culminating in a bachelor's thesis with oral examination by thesis committee resulting in a bachelor's degree with Honors upon completion. See Departmental Honors Program for more information. Completed in last three semesters before graduation. Offered for variable course credit from 1.00-2.00.

CS 492 Independent Study Off-Campus/NSOC
Student-driven independent study in a topic related to the major completed at an off-campus site. See Off-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.

COURSES IN MATHEMATICS

MATH 111 Pre-Calculus
An introduction to the concepts of college algebra, trigonometry, elementary function, and limits. This course is designed as a preparation for Math 151. Designed for students who plan to take Calculus I but have not had pre-calculus or higher in high school. This course does not meet the Quantitative Competency Requirement. (Each Fall)

MATH 120 Elementary Statistics
An introduction to the principles of probability, descriptive statistics, and inferential statistics: Topics in probability include axioms and theorems of probability, events, the distribution, mean, and variance of a random variable, and Binomial random variables. Topics in descriptive statistics include sampling, variables, frequency distributions and histograms, stem and leaf displays, means, medians, and modes. Topics in inferential statistics include hypothesis tests and confidence intervals for population means and proportions, Chi Square methods, ANOVA, and regression analysis. Requirements met: Quantitative Competency (pre-Fall 2019) and Quantitative Competency (Fall 2019 & after). (Each fall and spring)

MATH 151 Calculus I
The first course in the Calculus sequence. Included is an introduction to the differential and integral calculus of the elementary (algebraic, trigonometric, exponential and logarithmic) functions of a single real variable, the Fundamental Theorem of Calculus, and various applications. The central role of the limit concept is stressed throughout. PREQ: A high school or college course in pre-calculus. A grade of C or better is required to continue into higher numbered mathematics courses, in particular Mathematics 152 and Mathematics 251. Requirements met: Quantitative Competency (pre-Fall 2019). (Each fall and spring)

MATH 152 Calculus II
The second course in the Calculus sequence. Expounding on the first semester, the course includes the study of curves defined parametrically and defined via alternate coordinate systems, additional integration techniques, and further applications. The notion of infinite series is studied in detail and culminates in the theory of functions defined by power series. PREQ: Mathematics 151 with a grade of C or better. Requirements met: Quantitative Competency (pre-Fall 2019). (Each fall and spring)

MATH 250 Topics in Mathematics
A course exploring advanced or specialized topics in mathematics. May be repeated with permission of instructor when topic varies. PREQ: Mathematics 151. (Offered on an occasional basis)

MATH 251 Introduction to Linear Algebra
A course with twin goals. The first is to introduce the student to linear systems of equations and their solutions, vector spaces and subspaces, linear transformations, matrices, and eigenvalue/eigenvector theory. The second is to indoctrinate the student in basic proof techniques, as well as to expose the student to abstract thinking, thus providing a transition to upper-level work. PREQ: Mathematics 151 with a grade of C or better. (Each spring)

MATH 252 Calculus III (Multivariate)
The third course in the Calculus sequence. This extension of the Newton/Leibniz theory to higher dimensions involves the study of functions of more than one real variable. Both differentiation and integration are defined in this context, and the course culminates with a study of the classical theorems of Vector Calculus, generalizing the Fundamental Theorem of Calculus. PREQ: Mathematics 152 with a grade of C or better. Requirements met: Quantitative Competency (pre-Fall 2019). (Each fall)

MATH 260 Intermediate Directed Study
Student investigation of topic of interest working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Freshman January term or Sophomore standing. Special permission required. Offered in variable course credit from 0.25-1.00.

MATH 294 Intermediate Student Research
Intended for less experienced students to develop and execute a research project related to mathematics, beyond the constraints of the normal classroom, suitable for public dissemination on or off campus under mentorship of a faculty member. Typically, this work results in a formal presentation, written work, or creative works. Course credit varies from 0-1.00. PREQ: Instructor permission required.

MATH 295 Research Practicum
An individualized or small group research project conducted in communication with a member of the department. May be repeated when topic varies. Variable course credit. (Offered on an occasional basis)

MATH 301 Ordinary Differential Equations
A study of equations involving functions of one real variable and their derivatives. Topics typically include general first order theory, linear equations of higher order, series solutions, the Laplace transform, and numerical methods. PREQ: Mathematics 252. (Each spring)

MATH 319 Euclidean Geometry, ancient through modern
A course primarily intended for prospective teachers of mathematics. Its goal is to provide a broad study of Euclidean geometry from the early beginnings (before Euclid), continuing through many historically important eras, and continuing into modern times. Throughout, proofs and proof techniques will play a prominent role. Also, considerable attention will be given to constructions with the classical tools, constructions with other tools sets, and more generally to the important history of the famous construction problems of antiquity. Various drawing schemes (3-d visualization) will be included, along with the associated impact on the discovery of non-Euclidean systems. Attention to Hilbert's axioms for Euclidean Geometry and subsequent work on the subject is a likely component, as is attention to higher dimensional Euclidean spaces. Recommended for prospective teachers of secondary school mathematics. PREQ: Mathematics 252 and instructor permission. (Every other year)

MATH 321 Numerical Analysis
A study typically including a review of appropriate topics in calculus, the Mean Value Theorem, Taylor series, order of convergence of sequences, solution of nonlinear equations, interpolation and polynomial approximation, numerical differentiation and integration, numerical solution of ordinary differential equations, and error analyses. PREQ: Mathematics 252. (Every other year)

MATH 360/460 Advanced Directed Study
Student investigation of topic of interest related to the major or minor working in collaboration with a faculty member resulting in significant oral and written work. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered for variable course credit from 0.25-1.00.

MATH 373 Knot Theory
Knot theory is a subdiscipline of mathematics in which we study knots as mathematical objects. A knot is exactly what it sounds like: take a string, tangle it up somehow, and then fuse the ends. Once we have the knots, we are allowed to move them around in space and we can ask many questions about them. Can this knot be untangled? Are these two knots the same? These questions are difficult to answer, so knot theory is a very active area of research in mathematics. In addition to being an active area of research, knot theory has applications to many other areas including chemistry, biology, and physics. This course is an introduction to classical knot theory including properties of knots, numerical invariants of knots, the Alexander and Jones polynomials, and applications of knot theory. PREQ: Mathematics 252. (Every other year)

MATH 381 Applied Analysis
A study typically building on Math 301: Review of first and second order ordinary differential equations; series solutions to ordinary differential equations (including the Frobenius solutions); solution of systems of linear differential equations using eigenvalues and eigenvectors; qualitative methods for systems of non-linear differential equations including predator-prey problems; special functions (Legendre polynomials, Bessel functions); Fourier Series, Sturm-Liouville boundary value problems and expansions in orthogonal functions; the wave equation, the heat equation, and the Laplace equation with constant coefficients. PREQ: Mathematics 252; Mathematics 301 recommended. (Every other year)

MATH 385 Probability Theory
A study of applied probability theory and its use in the formulation of statistical models. Course includes probability measures, random variables, expectation, and fundamental limit theorems. PREQ: Mathematics 252. (Every other year)

MATH 394/494 Advanced Student Research
Intended for advanced students to develop and execute a research project related to mathematics suitable for public dissemination under mentorship of a faculty member. Students are expected to present the results of their research in a public forum. Typically, this work results in a formal presentation, written work, or creative works. Course credit varies from 0-1.00. PREQ: Instructor permission required.

MATH 401 Mathematical Biology
A study of mathematical models of biological processes. Modeling examples will be drawn from fields such as epidemiology, ecology, and cancer biology. This course will include a computational component, allowing students to use technology to better understand the models and the biological systems they describe. PREQ: Mathematics 252.

MATH 409 Survey of Geometry
A course intended to provide a broad survey of many different geometries as well as of the varied methods of investigation of these systems. In particular, the more general notions of non-Euclidean geometry are stressed. Topics typically include Finite geometries, advanced topics in Euclidean geometry, Spherical geometry, Hyperbolic geometry, Projective geometry; some attention to higher dimensional versions of these systems will also be included. Further, consideration will be given to various non-homogeneous systems. Also, an introduction to the topology of compact surfaces may be included. PREQ: Mathematics 252. (Every other year)

MATH 419 Differential Geometry
A course intended primarily as an introduction to the local and global geometric theory of curves and surfaces. In addition to the development of appropriate mathematical machinery needed for the study of these objects, further likely topics include: curvature and torsion of space curves, the Frenet frame for curves; fundamental existence and congruence theorem for curves; curvature of curves on surfaces; curvature issues for surfaces; first and second fundamental forms; Gaussian curvature; geodesics; the Gauss map; Gauss-Bonnet theorem; Isoperimetric Inequality. Finally, some attention will be given to higher dimensional manifolds. PREQ: Mathematics 252. (Every other year)

MATH 450 Advanced Topics in Mathematics
A course exploring special topics in mathematics. May be repeated with permission of instructor when topic varies. Recent courses have included Algebraic Topology, Game Theory, Graph Theory, Number Theory, and Mathematics of Finance. PREQ: Mathematics 252. (Offered on an occasional basis)

MATH 464 Teaching/Learning Participation
An individualized study that includes sharing in the instructional process for a particular math course under the supervision of the faculty member teaching the course. Open only to certain highly qualified juniors and seniors by invitation. See On-Campus Learning Opportunities for more information.

MATH 472 Modern Algebra
A study of the basic abstract algebraic objects (groups, rings, and fields, et cetera) and the structure-preserving maps between them. PREQ: Mathematics 252 or instructor permission. (Every other year)

MATH 473 Topology
An introductory study typically covering the topological properties of Euclidean spaces, general topological spaces, generalized continuity, homeomorphisms, connectedness, compactness, separation properties, and

metrization. An introduction to the topology of compact surfaces also may be included. PREQ: Mathematics 252. (Every other year)

MATH 474 Number Theory
A study typically including mathematical induction, divisibility and primes, modular arithmetic, Diophantine Equations, arithmetical functions, and quadratic reciprocity. An introduction to cryptography and various other number theoretic applications may also be included. PREQ: Mathematics 252. (Every other year)

MATH 475 Mathematics of Finance
A study of expectation dynamics, portfolio management, interest rate analysis, arbitrage pricing theory, hedging, forwards and futures contracts, and options pricing theory. PREQ: Mathematics 252 (Every other year)

MATH 482 Real Analysis
A rigorous study of the calculus of functions of one and several real variables. Emphasis is placed on the topology of euclidean spaces, the concepts of limit and convergence, and a detailed analysis of the corresponding fundamental theorems. PREQ: Mathematics 252. (Every other year)

MATH 483 Complex Analysis
An introduction to the study of the calculus of functions of a complex variable. Topics typically include basic Cauchy theory, analysis of basic holomorphic functions, zeroes and singularities, Taylor and Laurent series, and residue theory. PREQ: Mathematics 252. (Every other year)

MATH 490 Independent Study
Student-driven independent work to produce a high quality body of work such as paper, report, art project, etc. See On-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.

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Extensive independent study in the major in a topic of special interest culminating in a bachelor's thesis with oral examination by thesis committee resulting in a bachelor's degree with Honors upon completion. See Departmental Honors Program for more information. Completed in last three semesters before graduation. Offered for variable course credit from 1.00-2.00.

MATH 492 Independent Study Off-Campus/NSOC
Student-driven independent study in a topic related to the major completed at an off-campus site. See Off-Campus Learning Opportunities for more information. PREQ: Junior or Senior standing. Special permission required. Offered in variable course credit from 0.25-1.00.

MATH 495 Senior Conference
See program faculty for more information.