MASTER OF SCIENCE IN MATHEMATICS
Candidates for the degree of Master of Science in Mathematics must complete thirty (30) credits of approved 400-level courses offered by the Department of Mathematics and Computer Science numbered 400 or above, with a minimum of six (6) credits completed in 500-level courses.

A thesis option is available whereby a candidate can write and defend a written thesis under the direction of a faculty advisor. At most, six of the required thirty credits may be earned through thesis work. Students electing a thesis option should consult the department chairperson for details regarding thesis-preparation guidelines.

CS. COMPUTER SCIENCE

CS-419. PRINCIPLES OF PROGRAMMING LANGUAGES
Credits: 3
A study of the principles that govern the design and implementation of programming languages. Topics include language structure, data types, and control structures. Programming projects will familiarize students with the features of programming languages through their implementation in interpreters.

Pre-Requisites
CS-226 or equivalent

CS-421. SIMULATION AND DATA ANALYSIS
Credits: 3
Methods of handling large databases including statistical analysis and computer simulations. The emphasis will be upon discrete simulation models with a discussion of relevant computer languages, SLAM, GPSS, and/or SIMSCRIPT.

Pre-Requisites
CS-125 (or the equivalent programming experience) and one semester of calculus.

CS-423. THEORY OF COMPUTATION
Credits: 3
This course formalizes many topics encountered in previous computing courses. Topics include: languages, grammars, finite automata, regular expressions and grammars, context-free languages, push-down automata, Turing machines and computability.

Pre-Requisites
MTH-232 (Discrete Mathematics II) and CS-126 (or the equivalent programming experience).

CS-424. SYSTEMS ANALYSIS
Credits: 3
A study of the design and implementation of large computer projects. Special emphasis is placed on applications to business systems. Students will use a CASE tool for automated systems analysis and design.

Pre-Requisites
CS-226 or equivalent

CS-425. DATABASE MANAGEMENT
Credits: 3
Practical experience in solving a large-scale computer problem including determination of data requirements, appropriate data organization, data manipulation procedures, implementation, testing and documentation.

Pre-Requisites
CS-126 or permission of the instructor.

CS-426. OPERATING SYSTEM PRINCIPLES
Credits: 3
Analysis of the computer operating systems including Batch, Timesharing, and Realtime systems. Topics include sequential and concurrent processes, processor and storage management, resource protection, processor multiplexing, and handling of interrupts from peripheral devices.

Pre-Requisites
CS-226 or equivalent

CS-427. COMPILER DESIGN
Credits: 3
A study of compiler design including language definition, syntactic analysis, lexical analysis, storage allocation, error detection and recovery, code generation and optimization problems.

Pre-Requisites
CS-226 or equivalent

CS-428. ALGORITHMS
Credits: 3
Theoretical analysis of various algorithms. Topics are chosen from sorting, searching, selection, matrix multiplication and multiplication of real numbers, and various combinational algorithms.

Pre-Requisites
CS-226 or equivalent and MTH-232 (Discrete Mathematics II).

CS-430. COMPUTER ARCHITECTURE
Credits: 3
A study of the design, organization, and structure of computers, ranging from the microprocessors to the latest 'supercomputers.'

Pre-Requisites
CS-226 or equivalent

CS-434. SOFTWARE ENGINEERING
Credits: 3
A course in 'programming in the large.' Topics include software design, implementation, validation, maintenance and documentation. There will be one or more team projects. Prerequisite CS-226 or equivalent

CS-435. ADVANCED DATABASE CONCEPTS
Credits: 3
Practical experience involving unstructured data collections. Topics cover big data, data mining, predictive modeling, decision analysis, and indexing and retrieval including probabilistic, clustering, thesauri, and passage based retrieval strategies.

Pre-Requisites
CS-325 (Database Management) or CS340 Artificial Intelligence
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CS-440. ARTIFICIAL INTELLIGENCE
Credits: 3
This course will provide an overview of artificial intelligence (AI) application areas and hands-on experience with some common AI computational tools. Topics include search, natural language processing, theorem proving, planning, machine learning, robotics, vision, knowledge-based systems (expert systems), and neural networks.

Pre-Requisites
CS-126 (Unix) and equivalent programming experience in a high-level language.

CS-450. OBJECT-ORIENTED PROGRAMMING
Credits: 3
Object-oriented concepts and their application to human-computer interaction. Concepts to be covered include objects, classes, inheritance, polymorphism, design patterns, GUI interface guidelines and design of interfaces. There will be programming projects in object-oriented languages.

Pre-Requisites
CS-226 or equivalent

CS-455. COMPUTER NETWORKS
Credits: 3
This course introduces basic concepts, architecture, and widely used protocols of computer networks. Topics include the Open System Interconnection (OSI) model consisting of physical link layer, data layer, network layer, transport layer, session layer, presentation layer, and application layer, medium access sublayer and LAN; various routing protocols; Transmission Control Protocol (TCP) and Internet Protocol (IP) for internetworking.

Pre-Requisites
Either CS-225 and CS-246

CS-463. OPERATIONS RESEARCH
Credits: 3
A survey of operations research topics such as decision analysis, inventory models, queueing models, dynamic programming, network models, and linear programming. (Cross-listed with MTH-463)

Pre-Requisites
Programming experience in a high-level language and completion of one semester of calculus.

CS-464. NUMERICAL ANALYSIS
Credits: 3
An introduction to numerical algorithms as tools to providing solutions to common problems formulated in mathematics, science, and engineering. Focus is given to developing the basic understanding of the construction of numerical algorithms, their applicability, and their limitations. (Cross-listed with MTH-464)

Pre-Requisites
Programming experience in a high-level language and completion of a one-year calculus sequence.

CS-467. COMPUTER GRAPHICS
Credits: 3
Introduction to equipment and techniques used to generate graphical representations by computer. Discussion of the mathematical techniques necessary to draw objects in two and three-dimensional space. Emphasis on application programming and the use of a high-resolution color raster display.

Pre-Requisites
CS-226 or equivalent

CS-483. WEB DEVELOPMENT
Credits: 3
An introduction to the development of dynamic, database-driven sites, including active server pages, PHP, authentication, session tracking and security, and the development of shopping cart and portal systems.

Pre-Requisites
CS-283 (Web Development I) and CS-325 (Database Management).

CS-498. TOPICS IN COMPUTER SCIENCE
Credits: variable
Variable creditStudy of one or more special topics in computer science. May be repeated for credit provided a different topic is selected.

MTH. MATHEMATICS

MTH-411. REAL ANALYSIS
Credits: 4
A rigorous treatment of fundamental concepts in analysis, with emphasis on careful reasoning and proofs. Topics covered include the completeness and order properties of real numbers; limits and continuity; conditions for integrability and differentiability; infinite sequences and series of functions. Basic notions of the topology of the real line are also introduced.

Pre-Requisites
MTH-302 (Introduction to Higher Mathematics) or consent of instructor

MTH-413. FUNCTIONS OF SEVERAL VARIABLES
Credits: 3
A modern treatment of calculus of functions of several real variables. Topics include: Euclidean spaces, differentiation, integration and manifolds leading to the classical theorems of Green and Stokes.

Pre-Requisites
MTH-214 (Linear Algebra) and MTH-411 (Real Analysis) or consent of instructor.

MTH-414. COMPLEX ANALYSIS
Credits: 3
Complex functions, limit, continuity, analytic functions, power series, contour integration, Laurent expansion, singularities and residues.

Pre-Requisites
MTH-212 (Multivariable Calculus) or consent of instructor.
MTH-431. ABSTRACT ALGEBRA I
Credits: 4
A rigorous treatment of fundamental concepts in algebra, with emphasis on careful reasoning and proofs. Topics covered include equivalence relations, binary operations, integers: divisibility, factorization, integers modulo n, elementary group theory, subgroups, cyclic groups, permutation groups, quotient groups. Homomorphisms and isomorphisms. Introductory topics in ring theory as time permits.

Pre-Requisites
MTH-302 (Introduction to Higher Mathematics) or consent of instructor

MTH-432. ABSTRACT ALGEBRA II
Credits: 3
A continuation of MTH-431. Includes the study of polynomial rings, ideals, field extensions and Galois Theory.

Pre-Requisites
MTH-431 (Abstract Algebra).

MTH-442. TOPOLOGY
Credits: 3
An introduction to point-set topology, including a study of metric spaces, topological spaces, countability and separation axioms, compactness, connectedness, product spaces.

Pre-Requisites
MTH-411 (Real Analysis) or consent of instructor.

MTH-443. GEOMETRY
Credits: 3
A study of selected topics from Euclidean and non-Euclidean geometry.

Pre-Requisites
MTH-302 (Introduction to Higher Mathematics) or consent of instructor

MTH-451. PROBABILITY AND MATHEMATICAL STATISTICS I
Credits: 3
Random variables, probability distributions, expectation and limit theorems, confidence intervals.

Pre-Requisites
A one-year calculus sequence or consent of instructor.

MTH-452. PROBABILITY AND MATHEMATICAL STATISTICS II
Credits: 3
Hypothesis testing, non-parametric methods, multivariate distributions, introduction to linear models.

Pre-Requisites
MTH-451 or consent of instructor.

MTH-454. STATISTICAL METHODOLOGY
Credits: 3
This course emphasizes applications, using statistical computer packages (R, SPSS) and real data sets from a variety of fields. Topics include estimation and testing; stepwise regression; analysis of variance and covariance; design of experiments; contingency tables; and multivariate techniques, including logistic regression.

Pre-Requisites
MTH-451 or consent of instructor.

MTH-461. PARTIAL DIFFERENTIAL EQUATIONS
Credits: 3
Fees: $40

Offered fall of odd years.

Pre-Requisites
MTH-211 (Differential Equations)

MTH-462. ADVANCED CALCULUS
Credits: 3
Fees: $40
Topics from advanced calculus, including matrix representation of differentials and the multivariable chain rule, vector calculus, curvilinear coordinates, tensors, change of variables in higher dimensions, improper multiple integrals, applications of line and surface integrals, differential forms and the general Stokes’ theorem, potential theory, and Taylor’s formula for functions of several variables.

Offered fall of even years

Pre-Requisites
MTH-212 (Multivariable Calculus)

MTH-463. OPERATIONS RESEARCH
Credits: 3
A survey of operations research topics such as decision analysis, inventory models, queuing models, dynamic programming, network models, and linear programming. Cross-listed with CS-463. Offered in the spring semester of odd-numbered years when demand warrants.

Pre-Requisites
Programming experience in a high-level language and completion of a one-year calculus sequence.

MTH-464. NUMERICAL ANALYSIS
Credits: 3
An introduction to numerical algorithms as tools to providing solutions to common problems formulated in mathematics, science, and engineering. Focus is given to developing the basic understanding of the construction of numerical algorithms, their applicability, and their limitations. (Cross-listed with CS-464)

Pre-Requisites
Programming experience in a high-level language and completion of a one-year calculus sequence.

MTH-465. NUMERICAL LINEAR ALGEBRA
Credits: 3
Direct and iterative methods for the solution of systems of linear equations, matrix decompositions, computation of eigenvalues and eigenvectors, and relaxation techniques. The theoretical basis for error analysis including vector and matrix norms. Applications such as least squares and finite difference methods. Offered spring semester of even-numbered years.

Pre-Requisites
MTH 214 and CS 125 (or equivalent programming experience)
MTH-470. READINGS IN MATHEMATICS
Credits: 3
Pre-Requisites
Consent of Mathematics Department Chairperson May be repeated for credit if a different topic is selected.

MTH-511. MEASURE AND INTEGRATION
Credits: 3
Measures, measurable functions, integration, convergence theorems, product measures, signed measures.
Pre-Requisites
MTH-442 or consent of instructor.

MTH-513. FUNCTIONAL ANALYSIS
Credits: 3
Topics include: Banach spaces, Lp-spaces, Hilbert spaces, topological vector spaces, and Banach algebra.
Pre-Requisites
MTH-411 and a course in linear algebra.

MTH-532. MODERN ALGEBRA
Credits: 3
A study of group theory (including the Sylow Theorems and solvable groups); ring theory (including the Noetherian rings and UFDs); modules, tensor algebra, and semi-simple rings.
Pre-Requisites
MTH-431, and a course in linear algebra or consent of instructor.

MTH-542. ALGEBRAIC TOPOLOGY
Credits: 3
Polyhedra, simplicial homology theory, cohomology rings, and homotopy groups.
Pre-Requisites
MTH-442.

MTH-590. THESIS WRITING
Credits: up-6
Pre-Requisites
Consent of Department Chairperson