

Mathematics (MATH)

MATH 100R

Math Leap

1:1:0

Fall, Spring, Summer

For students in STEM and related fields who desire to improve problem-solving skills and/or placement level in preparation for STAT 1040 and higher-numbered MATH courses. Addresses unique strengths and weaknesses of students, by providing group problem solving activities along with an individual assessment and study plan for mastering target material. Requires mandatory class attendance and a minimum number of hours per week logged into a preparation module, with progress monitored by a mentor. May be repeated for a maximum of 4 credits toward graduation. May be graded credit/no credit.

MATH 1050

College Algebra

4:4:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years one of the following: MAT 1000 or MAT 1010 with a grade of C or better or appropriate math placement score.

Includes inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of linear and nonlinear equations, matrices and determinants, arithmetic and geometric sequences, and the Binomial Theorem. May be delivered hybrid and/or online.

MATH 1055

College Algebra with Preliminaries

5:5:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years one of the following: MAT 1000 or MAT 1010 with a grade of C or better or appropriate math placement score.

Includes inequalities, functions and their graphs, polynomial and rational functions, exponential and logarithmic functions, systems of linear and nonlinear equations, matrices and determinants, arithmetic and geometric sequences, and the Binomial Theorem. May be delivered hybrid and/or online. Canvas Course Mats \$90/McGraw applies.

MATH 1060

Trigonometry

3:3:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 with a grade of C or higher or appropriate math placement score.

Includes the unit circle and right triangle definitions of the trigonometric functions, graphing trigonometric functions, trigonometric identities, trigonometric equations, inverse trigonometric functions, the Law of Sines and the Law of Cosines, vectors, complex numbers, polar coordinates, and rotation of axes.

MATH 1080

Precalculus

5:5:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years, one of the following: MAT 1000 or MAT 1010 with a grade of B or better or an appropriate math placement score.

Is an accelerated version of MATH 1050 and MATH 1060. Includes functions and their graphs including polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Covers inequalities, systems of linear and nonlinear equations, matrices, determinants, arithmetic and geometric sequences, the Binomial Theorem, the unit circle, right triangle trigonometry, trigonometric equations, trigonometric identities, the Law of Sines, the Law of Cosines, vectors, complex numbers, polar coordinates, and conic sections.

MATH 1090

College Algebra for Business

3:3:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years one of the following: MAT 1000 or MAT 1010 with a grade of C or better or appropriate math placement score.

Uses linear, quadratic, power, polynomial, rational, exponential, logarithmic, and logistic functions to analyze business applications such as market equilibrium, rates of change, cost-benefit analysis, and inflation. Includes systems of linear and non-linear equations and inequalities, matrices and matrix equations, sequences and series, and financial mathematics. Canvas Course Mats \$90/McGraw applies.

MATH 1100

Introduction to Calculus

4:4:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 with a grade of C or better or appropriate math placement score.

Provides an overview of the basic concepts and techniques of differential and integral calculus. Features applications in business, economics, and the life, social, and physical sciences. Includes optimization techniques in multivariable differential calculus.

MATH 1210

Calculus I

5:5:0

Fall, Spring, Summer

* Prerequisite(s): One of the following within the past two years: (MATH 1050 or MATH 1055) and MATH 1060, each with a grade of C or higher; MATH 1080 with a grade of C or higher; appropriate placement by math placement test.

Covers limits, continuity, differentiation, applications of differentiation, integration, and applications of integration, including derivatives and integrals of polynomial functions, rational functions, exponential functions, logarithmic functions, trigonometric functions, inverse trigonometric functions, and hyperbolic functions. Is a prerequisite for calculus-based sciences.

MATH 121H

Calculus I

5:5:0

Fall, Spring

* Prerequisite(s): One of the following within the past two years: (MATH 1050 or MATH 1055) and MATH 1060, each with a grade of C or higher; MATH 1080 with a grade of C or higher; appropriate placement by math placement test.

Covers limits, continuity, differentiation, applications of differentiation, integration, and applications of integration, including derivatives and integrals of polynomial functions, rational functions, exponential functions, logarithmic functions, trigonometric functions, inverse trigonometric functions, and hyperbolic functions. Is a prerequisite for calculus-based sciences. Is an honors course with student projects.

MATH 1220

Calculus II

5:5:0

Fall, Spring, Summer

* Prerequisite(s): MATH 1210 with a grade of C or higher

Includes integration techniques, arc length, area of a surface of revolution, moments and centers of mass, sequences and series, parametrization of curves and polar coordinates, vectors in 3-space, and quadric surfaces. Prerequisite for calculus-based sciences.

MATH 122H

Calculus II

5:5:0

Fall, Spring

* Prerequisite(s): MATH 1210 with a grade of C or higher

Includes integration techniques, arc length, area of a surface of revolution, moments and centers of mass, sequences and series, parametrization of curves and polar coordinates, vectors in 3-space, and quadric surfaces. Prerequisite for calculus-based sciences. Honors course which requires a student project.

MATH 2000

Algebraic Reasoning with Modeling QL

3:3:0

Fall, Spring, Summer

* Prerequisite(s): Within the past two years, one of the following: MAT 1000 or MAT 1010 with a grade of C or better or an appropriate math placement score.

Presents the basic ideas of sets and functions in the context of and motivated by modeling bivariate data. Includes basic set theory such as unions, intersections, Venn diagrams, etc. Includes the basic ideas and the algebra of functions including polynomial, exponential, and logarithmic functions. Also includes some basic combinatorics and counting principles as well as arithmetic and geometric sequences. Culminates in a pictorial introduction to the basic ideas of calculus presented with minimal computation.

Mathematics

MATH 2010

Mathematics for Elementary Teachers I

3:3:0 Fall, Spring, Summer

* Prerequisite(s): Within the past two years: MATH 1050 or MATH 1055 with a grade of C or better or appropriate math placement score.

Includes problem solving, sets, numeration systems, arithmetic of whole numbers, integers, rational numbers, real numbers, elementary number theory, ratios, proportions, decimals, and percents.

MATH 2020

Mathematics for Elementary Teachers II

3:3:0 Fall, Spring, Summer

* Prerequisite(s): MATH 2010 with a grade of C or higher

The second semester of the mathematics course for elementary teachers; includes topics on probability, statistics, geometry and measurement.

MATH 2210

Calculus III

3:3:0 Fall, Spring, Summer

* Prerequisite(s): MATH 1220 with a grade of C or higher

Includes partial derivatives, gradient, Lagrange multipliers, multiple integrals, line integrals, Green's Theorem, surface integrals, the Divergence Theorem, and Stokes' Theorem.

MATH 221H

Calculus III

3:3:0 Fall, Spring

* Prerequisite(s): MATH 1220 with a grade of C or higher

Includes partial derivatives, gradient vectors, Lagrange multipliers, multiple integrals, line integrals, Green's Theorem, surface integrals, the Divergence Theorem, and Stokes' Theorem. An honors course which includes a student project.

MATH 2250

Differential Equations and Linear Algebra

4:4:0 On Sufficient Demand

* Prerequisite(s): MATH 1220 with a grade of C or higher

For engineering students. Includes separable equations, linear differential equations, differential operators and annihilators, variation of parameters, Laplace transforms, systems of linear differential equations, and numerical methods. Introduces basic concepts of linear algebra including matrices, Gaussian elimination, determinants, linear independence, and eigenvalues and eigenvectors.

MATH 2270

Linear Algebra

3:3:0 Fall, Spring

* Prerequisite(s): MATH 1220 with a grade of C or higher

Includes matrices and systems of equations, determinants, vector spaces, linear transformations, orthogonality, and eigenvalues and eigenvectors.

MATH 2280

Ordinary Differential Equations

3:3:0 Fall, Spring

* Prerequisite(s): MATH 2210 with a grade of C or higher

Includes separable equations, linear differential equations, differential operators and annihilators, variation of parameters, power series solutions of differential equations, Laplace transforms, systems of linear differential equations, and numerical methods.

MATH 281R

Cooperative Work Experience

2 to 9:2 to 9:0 Fall, Spring, Summer

* Prerequisite(s): Approval of Cooperative Coordinator

Designed for mathematics majors. Provides paid work experiences in the student's major. Course content is individualized, with the student setting the objectives by consulting with a faculty coordinator and the on-the-job supervisor. Credit is determined by the number of hours the student works during the semester. Repeatable for a maximum of 16 credits toward graduation. May be graded credit/no credit.

MATH 290R

Topics in Mathematics

3 to 5:3 to 5:0 On Sufficient Demand

* Prerequisite(s): Departmental approval

Studies a chosen topic in mathematics; topic will vary depending upon student demand and course development needs. May be taken more than once for different topics and for a maximum of 6 credit hours counted toward graduation.

MATH 3000

History of Mathematics

3:3:0 Spring

* Prerequisite(s): MATH 2210 with a grade of C or higher and University Advanced Standing

Provides a survey of the history of mathematics.

MATH 3010

Methods of Secondary School Mathematics

Teaching

3:3:0 Fall

* Prerequisite(s): MATH 2210 with a grade of C or higher and EDSC 4550 with a grade of B- or higher and University Advanced Standing

For Mathematics Education majors. Presents different methods of teaching mathematical ideas at the secondary school level. Includes classroom instruction, students presentations, and field experiences. Studies various techniques of assessment and classroom management.

MATH 3020

Computer Based Mathematics for

Secondary School Mathematics Teachers

3:3:0 Fall

* Prerequisite(s): (MATH 2210 and MATH 2270 each with a grade of C or higher) and University Advanced Standing; MATH 2280 with a grade of C or higher is recommended

For Mathematics Education majors. Presents one or more popular mathematical computer software packages. Includes mathematical problem solving and presentations of mathematical concepts using a computer as an aid. Introduces appropriate programming language.

MATH 3030

Algebra for Secondary Mathematics

Teaching

3:3:0 Spring

* Prerequisite(s): Math 1210 with a grade B- or higher and University Advanced Standing and Mathematics Department Adviser Approval

For Mathematics Education Majors: Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of algebra. Teaches algebra as an extension of number, operation, and quantity; various ideas of equivalence as it pertains to algebraic structures; patterns of change as covariation between quantities; connections between representations (tables, graphs, equations, geometric models, context); and the historical development of content and perspectives from diverse cultures. Focuses on deeper understanding of rational numbers, ratios and proportions, meaning and use of variables, functions (e.g., exponential, logarithmic, polynomials, rational, quadratic), and inverses.

MATH 3100

Foundations of Geometry

3:3:0 Fall, Spring

* Prerequisite(s): MATH 2270 with a grade of C or higher and MATH 2210 with a grade of C or higher and University Advanced Standing
* Prerequisite(s) or Corequisite(s): MATH 2280

Introduces logic and mathematical proof. Offers an axiomatic development of Euclidean and non-Euclidean geometries.

MATH 3200

Foundations of Analysis

3:3:0 Spring, Summer

* Prerequisite(s): MATH 3100 with a grade of C or higher and MATH 2280 with a grade of C or higher and University Advanced Standing

Covers material from beginning analysis including the axioms of the real numbers, sequences, mathematical induction, limits, topology of the real line, continuity, differentiation, and integration.

MATH 3210**Complex Variables****3:3:0** **Fall**

* Prerequisite(s): MATH 2210 with a grade of C or higher and University Advanced Standing

Introduces complex analysis. Includes algebra of complex numbers, analytic functions, mapping properties of elementary functions, the Cauchy integral formula, complex series, residues, and conformal mapping.

MATH 3250**Introduction to Advanced Calculus****3:3:0** **Fall, Spring**

* Prerequisite(s): MATH 2270 with a grade of C or higher and MATH 2210 with a grade of C or higher and University Advanced Standing

* Prerequisite(s) or Corequisite(s): MATH 2280

Introduces mathematical logic and proof. Covers the first topics of advanced calculus including the axioms of the real numbers, sequences, mathematical induction, limits, topology of the real numbers, continuity, differentiation, and integration.

MATH 3300**Foundations of Abstract Algebra****3:3:0** **Fall, Spring**

* Prerequisite(s): MATH 3100 or MATH 3250 with a grade of C or higher and University Advanced Standing

Provides an introduction to algebraic structures. Covers the theory of groups including modular arithmetic, normal subgroups, factor groups, and cyclic groups. Introduces rings, integral domains, and fields.

MATH 3310**Discrete Mathematics****3:3:0** **On Sufficient Demand**

* Prerequisite(s): MATH 1220 with a grade of C or higher and University Advanced Standing

Includes logic, sets, functions, elementary number theory, mathematical induction, equivalence relations, and cardinality. Emphasizes the writing of proofs.

MATH 3320**Graph Theory and its Applications****3:3:0** **Fall Even Year**

* Prerequisite(s): MATH 2270 with a grade of C or higher and University Advanced Standing

Introduces the most important topics of graph theory including graphs and modeling, trees, paths, circuits, and connectivity, matching, planar graphs and coloring, and applications.

MATH 3400**Partial Differential Equations****3:3:0** **Spring**

* Prerequisite(s): MATH 2280 with a grade of C or higher and University Advanced Standing

Introduction to partial differential equations. Topics include Bessel functions, Legendre polynomials, Fourier analysis, partial differential equations, and boundary value problems.

MATH 3640**Introduction to Optimization****3:3:0** **Fall Odd Year**

* Prerequisite(s): MATH 2210 and MATH 2270 with a grade of C or higher and University Advanced Standing; CS 1400 with a grade of C or higher is recommended.

Includes linear, quadratic, and nonlinear programming, network problems, convexity, necessary and sufficient optimality conditions, numerical algorithms, and special topics.

MATH 3750**Financial Mathematics****3:3:0** **Fall, Spring, Summer**

* Prerequisite(s): (MATH 1220 or FIN 3100 each with a grade of C or higher) and University Advanced Standing

Prepares students to take Exam FM/Exam 2 given by the Society of Actuaries/Casualty Actuarial Society. Trains students to answer complex questions under significant time pressure. Teaches the principles and mathematics of interest, annuities, amortization, investments, financial economics, derivative investment contracts and financial risk management.

MATH 4015**Actuarial Problems Laboratory****1:0:3** **On Sufficient Demand**

* Prerequisite(s): STAT 4710 and University Advanced Standing

Provides preparation for the first actuarial examination by linking concepts of probability and mathematical statistics to actuarial applications.

MATH 4025**Actuarial Problems Finance Laboratory****1:0:3** **On Sufficient Demand**

* Prerequisite(s): (MATH 3750 or Departmental Approval) and University Advanced Standing

Provides preparation for the second actuarial examination by linking concepts of finance and derivative markets to actuarial applications frequently found on Exam FM/2.

MATH 4030**Geometry for Secondary Mathematics Teaching****3:3:0** **Fall**

* Prerequisite(s): Math 3100 with a grade C or higher and University Advanced Standing

For Mathematics Education Majors. Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of geometry. Teaches constructions and transformations, congruence and similarity, analytic geometry, solid geometry, conics, trigonometry, and the historical development of content and perspectives from diverse cultures. Makes explicit connections to various mathematical content strands (modeling, complex numbers, function, and algebra).

MATH 4040**Statistics and Probability for Secondary Mathematics Teaching****3:3:0** **Fall**

* Prerequisite(s): Math 1210 with a grade B- or higher and Math 2040 with a grade C or higher and University Advanced Standing

For Mathematics Education Majors. Includes the exploration of important conceptual underpinnings, common misconceptions and students' ways of thinking, appropriate use of technology, and instructional practices to support and assess the learning of statistics and probability. Focuses on summarizing and representing data, study design and sampling, probability, testing claims and drawing conclusions, and the historical development of content and perspectives from diverse cultures.

MATH 4100**Differential Geometry of Curves and Surfaces****3:3:0** **Fall Odd Year**

* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Presents the differential geometry of curves and surfaces. Includes parametrized curves, arc length, surfaces, tangent planes, area, curvature, the Gauss map, vector fields, isometries, geodesics, the Gauss-Bonnet theorem, and other curves and surfaces topics selected by the instructor.

MATH 4210**Advanced Calculus I****3:3:0** **Fall**

* Prerequisite(s): MATH 3250 with a grade of C or higher and MATH 2280 with a grade of C or higher and University Advanced Standing

Covers limit and differentiation theorems, L'Hopital's rule, integration, the Fundamental Theorem of Calculus, series convergence, Taylor series, compactness, and an introduction to the geometry and topology of Euclidean spaces.

MATH 4220**Advanced Calculus II****3:3:0** **Spring**

* Prerequisite(s): MATH 4210 with a grade of C or higher, and University Advanced Standing

Covers the topology of Euclidean spaces, vectors and linear transformations, multivariable limits and continuity, multivariable differentiation, Jordan regions, multivariable Riemann integration, and Taylor series in multiple variables.

MATH 4310**Introduction to Modern Algebra I****3:3:0** **Fall**

* Prerequisite(s): MATH 3300 with a grade of C or higher and University Advanced Standing

Provides a deeper treatment of topics in modern algebra. Covers direct products of groups and the classification of finite Abelian groups. Covers the theory of rings including ideals, factor rings, various kinds of integral domains, fields, and polynomial rings.

Mathematics

MATH 4320

Introduction to Modern Algebra II

3:3:0 **Spring**

* Prerequisite(s): MATH 4310 with a grade of C or higher and University Advanced Standing

Provides a deeper treatment of topics in the theory of groups, rings, and fields. Covers field extensions, algebraic extensions, finite fields, and Kronecker's Theorem. Includes applications to straightedge and compass geometric constructions. Covers other topics at the instructor's discretion which may include the Sylow Theorems, symmetry groups, and Galois Theory.

MATH 4330

Theory of Linear Algebra

3:3:0 **Spring**

* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Covers vector spaces, linear transformations and matrices, dual spaces, inner product spaces, orthogonality, bilinear forms, eigenvalues, eigenvectors and generalized eigenvectors, diagonalization, and Jordan and other canonical forms.

MATH 4340

Introduction to Number Theory

3:3:0 **Spring Even Year**

* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Covers divisibility, irreducibility and primality, linear Diophantine equations, Pell's equation, continued fractions, congruences, Euler's theorem, arithmetic functions, primitive roots, quadratic reciprocity.

MATH 4510

Foundations of Topology

3:3:0 **Fall Even Year**

* Prerequisite(s): MATH 3250 with a grade of C or higher and University Advanced Standing

Introduces the ideas of topologies, compactness, connectedness, countability, separability, separation axioms, homeomorphisms, and the Baire Category Theorem.

MATH 4610

Introduction to Numerical Analysis I

3:3:0 **Fall**

* Prerequisite(s): (MATH 2210, MATH 2270, and MATH 2280, each with a grade of C or higher), an approved programming language, and University Advanced Standing

Introduction to numerical analysis I. Topics will include numerical solutions of equations in one variable, numerical solutions of linear and nonlinear system of equations, interpolations and polynomial approximation, and approximating eigenvalues and eigenvectors.

MATH 4620

Introduction to Numerical Analysis II

3:3:0 **Spring**

* Prerequisite(s): MATH 4610 with a grade of C or higher and University Advanced Standing

Introduction to numerical analysis II. Topics will include numerical differentiation and integration, numerical solutions of initial-value problems and boundary-value problems for ordinary differential equations, numerical.

MATH 4750

Life Contingencies

3:3:0 **Spring Odd Year**

* Prerequisite(s): STAT 4710 with a grade of C or higher and University Advanced Standing

Includes survival models, Markov Chains, life insurance and annuities, and Poisson processes. Prepares students for the life contingencies portion of Exam M of the Society of Actuaries.

MATH 481R

Internship in Mathematics

1 to 4:1 to 4:0 **On Sufficient Demand**

* Prerequisite(s): Instructor Approval and University Advanced Standing

For mathematics majors. Provides mathematics-related work experience in an industrial, commercial, or research environment. Internship credit may not be used in fulfilling the mathematics major course requirements. May be taken two times for a maximum of 6 credits toward graduation. May be graded credit/no credit.

MATH 490R

Topics in Mathematics

2 to 3:2 to 3:0 **On Sufficient Demand**

* Prerequisite(s): Departmental approval and University Advanced Standing

Studies a chosen topic in mathematics. The topic will vary depending upon student demand. Course may be taken more than once for different topics and for a maximum of 6 credit hours counted toward graduation.

MATH 499R

Mathematics Capstone

2:2:0 **Spring**

* Prerequisite(s): Instructor approval, departmental approval, and University Advanced Standing

For mathematics majors, to be taken during the last semester before graduation. Reviews topics learned in the core undergraduate mathematics courses. Assesses student understanding through the Major's Field Test. Provides an opportunity for senior mathematics majors to participate in mathematical research under the supervision of a faculty member. Offers a setting in which students prepare a research paper and give oral presentations that describe their research.

MATH 5510

General Topology

3:3:0 **Spring Odd Year**

* Prerequisite(s): MATH 4510 or MATH 4210 with a grade of C or higher

Introduces the fundamentals of general topology, including topological spaces, separation axioms, continuity, compactness, connectedness, metric spaces, product spaces, metrization and ordinals.

MATH 6100

Topics in Geometry and Topology

3:3:0 **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Includes manifolds, fundamental group, classification of surfaces, covering spaces, homotopy types, differential geometry, Riemannian geometry, algebraic geometry, projective geometry, and algebraic topology. May be delivered online.

MATH 6310

Modern Algebra

3:3:0 **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Reviews the basics of ring theory. Analyzes ideals and factor rings in detail to prepare students for the study of fields. Uses the basics of field theory, including the construction of field extensions, to prove the impossibility of the three great construction problems of antiquity. Concludes with an introduction to Galois Theory.

MATH 6350

Introduction to Combinatorics

3:3:0 **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Enumerates permutations and combinations of sets and multi-sets, inclusion-exclusion, recurrence relations, generating functions, Polya theory, and combinatorial structures.

MATH 6410

Topics in Ordinary Differential Equations

3:3:0 **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Includes the theory of linear and nonlinear ordinary differential equations and dynamical systems; the initial-value problems and behavior of solutions; the existence, uniqueness, perturbations, continuous dependence of solution on initial conditions, and introduction of nonlinear dynamical systems with applications.

MATH 6610**Numerical Methods and Modeling****3:3:0** **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Investigates modelling and numerical topics. Investigates topics from college algebra, calculus, linear algebra, and differential equations from a theoretical as well as numerical perspective. Expounds on algorithms and modelling through software packages in a hands-on approach.

MATH 6620**Topics in Numerical Analysis****3:3:0** **Fall, Spring**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Develops a deeper practical and theoretical understanding of methods used to find approximate solutions of a variety of mathematical problems and of the relationships between these algorithms. Compares accuracy, efficiency, and stability of methods used to solve nonlinear equations and large systems of linear and nonlinear algebraic equations; ordinary and partial differential equations; and to perform numerical differentiation, integration, interpolation and more general approximation of functions. Provides experience programming and applying many of the central algorithms that have powered modern advances in math and the sciences.

MATH 6700**Applications of Mathematics****3:3:0** **On Sufficient Demand**

* Prerequisite(s): Mathematics Endorsement 4, or instructor approval

Introduces various areas of mathematics that can be applied to other fields such as the sciences, arts, industry, etc. Includes topics such as game theory, graph theory, knot theory, number theory, etc.