

# MATH (MTH)

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## **MTH 007. Intermediate Algebra. 0 Credit Hour.**

A non-credit, pre-college course in intermediate algebra stressing graphing and equation solving, algebraic manipulation, laws of exponents functions, and logarithms.

## **MTH 090. Precalculus. 0 Credit Hour.**

A non-credit, pre-college course in algebra and trigonometry, covering functions (including exponential, logarithmic and trigonometric functions), analytic trigonometry, linear algebra (including system of equations, matrices, and determinants) and analytic geometry. This course does not satisfy the core mathematics requirement.

Prerequisite: Three years of high school mathematics.

## **MTH 102. Mathematics for Educators. 3 Credit Hours.**

A problem-solving oriented course for prospective elementary school teachers. Topics will include some of the following: properties of number systems, place value and scales of notation, elementary number theory, geometry and measurement, statistics probability. Open only to students in the Elementary Education program. Offered each Fall.

Prerequisite: Three units of high-school mathematics or MTH 007.

## **MTH 103. Elections, Voting and Mathematics. 3 Credit Hours.**

This course focuses on three main topics relating math and politics. Polling is a tool ubiquitous in politics. We will determine what makes a good poll, and how much information one can actually infer from a poll. From there we will study the many, and sometimes apparently contradictory, statistical claims made by candidates, ads, and pundits in order to advance their positions. By using mathematical reasoning we will determine what truth lies behind these claims. Finally, we will look at voting to see how much your vote actually counts. We will also compare our (US) voting systems to others around the world, and try to understand what makes a voting system "fair."

## **MTH 104. Mathematics for Decision Making. 3 Credit Hours.**

We all need to make decisions. As citizens, we need to sift through the mountain of (often misleading) data that is constantly being thrown our way by advertisers, the media, politicians, etc. As professionals, we may need to make decisions using data from such diverse areas as economics, social policy, health care, the military, or the environment. In any role, we need to know how data can be turned into useful information. This course covers mathematics used to analyze data in order to make good, informed decisions. Major topics include informal logic, data interpretations, basic probability, introductory statistics, and economics.

## **MTH 110. Introduction to Statistics I (no Computer Lab). 3 Credit Hours.**

A data-oriented, applied introduction to statistics. Topics include descriptive statistics, data distributions, random sampling, relationships, confidence intervals and hypothesis testing. Statistical software will be used throughout this course. Students may not take both MTH 110 and MTH 111.

Prerequisite: Three years of regents- level mathematics.

## **MTH 111. Introduction to Statistics I (with Computer Lab). 4 Credit Hours.**

A data oriented, applied introduction to statistics; includes a two hour per week computer lab. Topics include descriptive statistics, data distributions, random sampling, relationships, confidence intervals and hypothesis testing. Statistical software will be used throughout this course. Prerequisite: Three years of Regents-level mathematics. Students may not take both MTH 110 and MTH 111.

## **MTH 112. Introduction to Statistics II. 3 Credit Hours.**

This course is a continuation of MTH 110 and MTH 111. Further methods of statistics and their use in life will be covered. It includes: inference for one and two population means, inference for two proportions and two variances, inference for simple and multiple regression, categorical data analysis, analysis of variance, nonparametric tests and logistic regression. A statistical program will be used throughout this course. Prerequisites: MTH 110, MTH 111 or equivalent.

## **MTH 120. Mathematics for Business Majors. 3 Credit Hours.**

This course includes the following topics: exponential functions and models, mathematics of finance, linear systems and matrices, linear programming, derivatives. There is particular emphasis on applied problems. Students may not take both MTH 120 and MTH 123.

Prerequisite: three units of high-school mathematics or MTH 007.

## **MTH 122. Brief Calculus. 3 Credit Hours.**

Elementary functions, exponential and logarithmic functions, continuity, derivatives, max-min methods and applications. Primarily for students in economics and accounting.

Prerequisite: three units of high-school mathematics including intermediate algebra.

## **MTH 123. Mathematics for Act Majors. 3 Credit Hours.**

An introduction to various contemporary applications of mathematics drawn from the following topics: linear algebra, combinatorics, graph theory, probability, modern algebra. The emphasis is on the interplay between theory and application in mathematics. Students may not take both MTH 120 and MTH 123.

Prerequisite: Four years of high school mathematics.

## **MTH 145. Calculus I. 4 Credit Hours.**

A study of differential and integral calculus of one variable and applications.

Prerequisite: four units of high-school mathematics or permission of the department chair.

## **MTH 146. Calculus II. 4 Credit Hours.**

A study of differential and integral calculus of one and several variables and applications. Differential equations and their solutions.

Prerequisite: Grade of C- or better in MTH 145 or permission of the department chair.

## **MTH 211. Advanced Statistical Methods. 3 Credit Hours.**

This course covers certain advanced topics used for planning, executing, and evaluating statistical studies based on experiments, surveys, and observational datasets. The goals of this course are to further statistical literacy, to deepen understanding of certain advanced statistical principles that are not covered in the current curriculum, to learn to use technology to analyze data and aid in conceptual understanding, and to learn to use statistics to help understand and solve real-world problems.

Prerequisite(s): MTH 110 or MTH 111 and MTH 112 or STA 201 and STA 202.

**MTH 212. Statistical Consulting. 3 Credit Hours.**

This course will introduce students to the challenges of working with real data. Students will collaborate with faculty or other students on real research projects, and act as the main data analyst for a real scientific project. The course will cover how to meet with clients, how to write reports, how to clean and manage data, and how to present results. Most particularly, the course will cover how best to analyze a data set based on the research questions of interest, and will teach the students the skills they need to run these analyses.

Prerequisite: MTH 211.

**MTH 245. Calculus III. 4 Credit Hours.**

Multi-variate calculus with vectors. Line integrals and Green's theorem.

Prerequisite: A grade of C- or better in MTH 146 or permission of the department chair.

**MTH 260. Discrete Mathematics. 3 Credit Hours.**

This course covers the fundamental mathematical principles relevant to computer science, applied mathematics, and engineering. Topics included are propositional logic, predicate logic, proof techniques, (with an emphasis on mathematical induction), basics of counting and discrete probability.

Prerequisite: Grade of C- or better in MTH 145, or permission of the department chair.

Cross-listed Courses: CSC 281

**MTH 261. Linear Algebra. 3 Credit Hours.**

Systems of linear equations, matrix algebra, vectors and vector spaces, linear transformations, inner product spaces, determinants, characteristic values and vectors. (Offered each Fall) Students will not be able to get credit for both MTH 261 and MTH 304.

Prerequisites: MTH 145, MTH 146 (grade of C- or better), or permission of the department chair.

**MTH 303. Differential Equations and Mathematical Modeling. 3 Credit Hours.**

Differential equations play a vital role in modeling nearly every physical, chemical, and biological process. Understanding how to create and interpret mathematical models, as well as how to solve and characterize solutions of differential equations, is of fundamental importance to applied mathematics, contemporary science, and engineering.

This course provides a first introduction to this ubiquitous field of analysis with a heavy emphasis on the development, refinement, and interpretation of mathematical models using differential equations. The first portion of the course examines the various analytical, qualitative and numerical techniques available for analyzing the solutions of linear and nonlinear first-order differential equations (topics include separable equations, linear equations, transformation of variables, series methods, integral transforms, slope fields, equilibria, Euler's Method, and bifurcations). The second portion of the course focuses on techniques for studying systems of first-order differential equations (topics include direction fields, phase planes, Euler's Method for systems, homogeneous and nonhomogeneous linear systems, and the linearization of nonlinear systems). Students will not be able to get credit for both MTH 303 and MTH 304.

Prerequisite: MTH 146 (grade of C- or better) or permission of the department chair.

**MTH 304. Differential Equations for Scientists And Engineers. 4 Credit Hours.**

Primarily intended for physics and pre-engineering majors, this course integrates the study of linear algebra and differential equations with substantial emphasis placed on understanding the deep connections between these foundational fields of study. Linear algebra topics covered in this course include Gauss-Jordan elimination, matrix algebra, inverse matrices, determinants, eigenvalues/eigenvectors, linear transformations, vector spaces, linear independence, span, basis and dimension. Differential equations topics covered in this course include separable equations, linear equations, transformation of variables, series methods, integral transforms, slope fields, Euler's Method, homogeneous and nonhomogeneous linear systems, and basic solution techniques for solving partial differential equations. Students will not be able to get credit for both MTH 261 and MTH 304, or for both MTH 303 and MTH 304.

Prerequisites: Grade of C- or better in MTH 245.

**MTH 306. Topics in Number Theory. 3 Credit Hours.**

Elementary properties of integers, divisibility and related concepts, methods of representing integers, functions of number theory, simple diophantine equations, special sequences and series. Offered every other fall.

Prerequisite: Grade of C- or better in MTH 260 or MTH 261 or permission of the department chair.

**MTH 307. Combinatorial Mathematics and Graph Theory. 3 Credit Hours.**

Some classical puzzles of recreational mathematics; enumeration techniques; combinatorial designs; graph theory and network flows.

Prerequisite: Grade of C- or better in either MTH 260 or MTH 261, or permission of the department chair.

**MTH 311. Introduction to Probability Theory. 3 Credit Hours.**

Basic probability theory, combinatorial analysis, independence and dependence. Discrete and continuous distributions, random variables, random vectors, multivariate distributions. Expectations and moment generating functions. Binomial, normal, Poisson and related distributions. Sums and sequences of random variables. Central limit theorem. (Offered each fall.)

Prerequisites: Grade of C- or better in MTH 245 or permission of the department chair.

**MTH 312. Mathematical Statistics. 3 Credit Hours.**

Distributions related to the normal. Estimation: consistency, unbiasedness, mean square error, sufficiency, method of moments, maximum likelihood estimates, confidence limits and intervals. Bayesian intervals. Tests of hypotheses: tests of simple hypotheses, Neyman-Pearson lemma, Bayes procedures, composite hypotheses, generalized likelihood ratio tests. Non-parametric procedures. Simple linear regression. (Offered every other spring.)

Prerequisite: MTH 311.

**MTH 313. Applied Statistics. 3 Credit Hours.**

Review of statistical methods. Simple and multiple linear regression. Regression diagnostics. Time series models. Moving average, autoregressive and ARIMA models. Forecasting with regression and time series models. (Offered every other spring.)

Prerequisites: MTH 311.

**MTH 314. Actuarial Probability. 1 Credit Hour.**

This is a course designed to prepare students to pass the actuary exam P. This course covers actuarial applications of set theory, combinatorial probability, Bayes theorem, probability density functions, joint probability functions, and marginal and conditional probability. It also introduces several advanced topics, including transformations, order statistics, and a number of named distributions not covered in MTH 311.

Prerequisites: C- or better in MTH 311.

**MTH 332. Real Analysis. 4 Credit Hours.**

An introduction to techniques of mathematical proof, with emphasis on the recognition and evaluation of problem structures common to all areas of mathematics. Application of these techniques to a detailed description of the Real Number system. Examination of the algebraic, set-theoretic and topological structures of the Real Number system (completeness, compactness, connectedness) and real sequences. (Offered each spring.)

Prerequisites: Grades of C- or better in MTH 245, or permission of the department chair.

**MTH 335. Intro to Complex Variables. 3 Credit Hours.**

The complex number system. Differentiability and the Cauchy-Riemann conditions. The exponential, trigonometric and logarithm functions. Complex integration; the Cauchy integral theorem and its implications. Consequences of the Cauchy integral formula. Taylor and Laurent series, singularities.

Prerequisite: Grade of C- or better in MTH 245, or permission of the department chair.

**MTH 341. Abstract Algebra. 3 Credit Hours.**

Introduction to group theory. Cyclic, Abelian, symmetric and product groups. Subgroups, equivalence relations, homomorphisms. (Offered each fall.)

Prerequisite: Grade of C- or better in MTH 261 or permission of the department chair.

**MTH 361. Modern Geometry. 3 Credit Hours.**

Topics from the foundations of geometry, non-Euclidean geometry, transformation theory, dissection theory, convexity. (Offered every spring.)

Prerequisite: Grade of C- or better in MTH 261 or permission of the department chair.

**MTH 370. Intermediate Problem Solving. 3 Credit Hours.**

A working introduction to general heuristic reasoning (including specialization, generalization, analogy and induction) useful in solving mathematical problems. (Offered every spring.)

Prerequisite: Grade of C- or better in MTH 245 or permission of the department chair.

**MTH 390. Independent Study. 1-3 Credit Hours.**

A student who wishes to pursue an independent study project for academic credit must submit, prior to registration, a proposed plan of study that includes the topic to be studied and goal to be achieved, the methodology to be followed, schedule of supervision, end product, evaluation procedure and number of credits sought. The proposal must be approved by the supervising faculty member, the department chair and the dean of arts and sciences.

**MTH 421. Numerical Methods. 3 Credit Hours.**

The development of algorithms for and error analysis of: solutions of equations, interpolation and approximation, numerical differentiation and integration, numerical solutions of differential equations. Also, knowledge of a high level programming language. (Offered every other fall.)

Prerequisites: Grade of C- or better in MTH 245 and MTH 261 or permission of the department chair.

Cross-listed Courses: CSC 421

**MTH 481. Topology. 3 Credit Hours.**

Topological spaces; separation and countability properties. Mappings and continuity. Compactness and connectedness of various types. Product and quotient spaces.

Prerequisite: MTH 332 or permission of the department chair.

**MTH 490. Internship. 1-6 Credit Hours.**

A limited number of internships are available to students to provide them with practical experience in the applications of mathematics in business.

Prerequisites: Senior standing in mathematics and prior consultation with department chair.

**MTH 494. Preparation for Mathematical Research. 1 Credit Hour.**

This course is designed solely for Mathematics majors with an aim of making students understand, annotate and communicate (both verbally and in written form) the contents of a mathematical/statistical article. Also discussed will be the basics of the scientific document preparation system LaTeX.

**MTH 495. Senior Research Project. 3 Credit Hours.**

This course, exclusively for senior mathematics majors, involves the completion and presentation of a research project in the student's area of concentration. Prior to registration for the course, a student must submit a proposal and have it approved by the department chair. Students may work in teams of two or three on projects; however, team projects will require commensurably greater scope than individual projects.