

# MATHEMATICS (MATH)

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## MATH 407 - CHAOS AND FRACTALS

Introduction to discrete and continuous dynamical systems; stability; chaotic behavior; fractals and fractal measures.

Credits: 3

Course Notes: Math 233 and Math 246, Math 307 recommend

## MATH 409 - DATA MINING

Methods of knowledge discovery in massive data, i.e. the study of computer-assisted process of digging through and analyzing enormous data sets and then extracting the "meaning" of the data by applying mathematical methods. The methods that we study in this course are designed to predict behaviors and future trends based on existing data. Topics include classifications techniques, clusterization techniques, association rule discovery techniques, techniques for improving data quality. See CST 421.

Credits: 3

Course Notes: Math 246 and (Math 217 or Math 347)

## MATH 410 - FORMAL LANGUAGES & AUTOMATA

Finite automata and regular languages; push-down automata and context-free languages. Turing machines, linear-bounded automata, and context sensitive languages. See also Cst 410.

Credits: 3

Course Notes: CST 280

## MATH 416 - HISTORY OF MATHEMATICS

Evolution of mathematical ideas; major developments; problem solving, algorithms, and theoretical framework.

Credits: 3

Course Notes: MATH 231

## MATH 418 - NUMBER THEORY

Study of integers. Division and Euclidean algorithms, prime numbers, unique factorization; Diophantine equations; congruences; Fermat's and Euler's theorems; quadratic reciprocity.

Credits: 3

Course Notes: MATH 231 or MATH 245 or MATH 290 required

## MATH 420 - INTRODUCTION TO ABSTRACT ALGEBRA

Elementary properties of groups, rings, integral domains, and fields; symmetry; factorization of integers and polynomials; construction of quotient field of an integral domain.

Credits: 3

Course Notes: Math 245 and Math 246 required.

## MATH 423 - COOPERATION AND COMPETITION - GAME THEORY AND APPLICATIONS

Study of the ways in which strategic interactions among autonomous agents produce outcomes with respect to the preferences (or utilities) of those agents. This course covers game-theoretic foundations of cooperative and non-cooperative behavior of independent agents.

The course emphasizes applications drawn from artificial intelligence, decision theory, economics, psychology, business management and finance. See CST 423.

Credits: 3

Course Notes: Math 246 and (Math 245 or Math 217 or Math 448)

## MATH 428 - LINEAR PROGRAMMING & OPTIM

Models of optimization with linear constraints and objectives; simplex method and related algorithms; duality and sensitivity; transportation and assignment problems; games and network flows. See also Cst 428.

Credits: 3

Course Notes: MATH 246

## MATH 430 - NUMERICAL ANALYSIS

Solution of equations by iteration; interpolation; numerical differentiation and integration; numerical solutions to linear systems. Computer use course. See also Cst 330.

Credits: 3

Course Notes: MATH 232 and MATH 246

## MATH 432 - OPERATIONS RESEARCH

Stochastic methods in operations research. Queuing theory; Markov processes; decision analysis; simulation; stochastic dynamic programming.

Credits: 3

Course Notes: Math 231, Math 217 or Math 347.

## MATH 445 - COMBINATORICS

Permutations and combinations; identities involving binomial coefficients; inclusion-exclusion principle; recurrence relations; generating functions; introduction to theory of graphs.

Credits: 3

Course Notes: MATH 232 and (MATH 245 or MATH 290) all with a C- or higher, required.

## MATH 446 - STOCHASTIC PROCESSES

Poisson and renewal processes. Markov chains with applications to queuing theory, inventory control, and population growth.

Credits: 3

Course Notes: MATH 347

## MATH 447 - ADVANCED PROBABILITY

Probability models; random variables; probability distributions; expectation and moment generating functions of random variables; multivariate distributions.

Credits: 3

Course Notes: MATH 347

## MATH 448 - PROBABILITY AND STATISTICS II

Distributions of functions of random variables, sampling distributions; Central Limit Theorem; point estimators and confidence intervals; hypothesis testing; linear models.

Credits: 3

Course Notes: Math 347 or ACSC 347 with min grade C-.

## MATH 449 - REGRESSION & TIME SERIES

Simple and multiple linear regression models; time series analysis; applications to forecasting. Use of a statistical computer package; no previous experience with computers required.

Credits: 3

Course Notes: (MATH 231 and MATH 217) or MATH 348 or MATH 448

## MATH 450 - BOOLEAN ALG & SWITCH THEORY

Logic gates and Boolean algebras. Minimization of switching functions, and Karnaugh maps. Introduction to logic circuits, flip-flops, counters and registers. Digital arithmetic. See CST 450.

Credits: 3

Course Notes: MATH 245 or MATH 290 required.

## MATH 457 - ANOVA & EXPERIMENTAL DESIGN

One-way analysis of variance (ANOVA), multiple comparison methods, basic experimental designs, analysis of covariance (ANCOVA), factorial treatment structures, split plots, confounding and fractional replication in  $2^{n-k}$  factorial systems.

Credits: 3

Course Notes: MATH 217 or MATH 348 or MATH 448 or, PSYC 407 or MGMT 403

**MATH 458 - THEORY OF INTEGRATION**

The Lebesgue integral and its relation to the Riemann integral, convergence theorems, elements of measure theory.

Credits: 3

Course Notes: MATH 246 and MATH 352

**MATH 469 - ACTUARIAL MATHEMATICS I**

Survival distributions and life tables; life insurance; life annuities.

Credits: 3

Course Notes: MATH 347 and MATH 367

**MATH 470 - ACTUARIAL MATHEMATICS II**

Benefit premiums; benefit reserves; multiple life functions; multiple decrement models.

Credits: 3

Prerequisites: MATH 469

Course Notes: or Math 369 or Acsc 369 with a min grade C-

**MATH 475 - DERIVATIVES MARKETS**

We will cover binomial option pricing, the Black-Scholes Formula and equation, market-making and delta hedging, exotic options, the lognormal distribution, Monte Carlo valuation, Brownian motion and Itô parity and other option relationships, volatility, interest rate models.

Credits: 3

Course Notes: MATH 367, FIN 311,, or consent of Instructor.

**MATH 476 - LOSS MODELS**

Actuarial models; classifying and creating distributions; frequency and severity with coverage modifications; construction of empirical models; estimation for complete data; estimation for modified data; parameter estimation; interpolation and smoothing; simulation.

Credits: 3

Prerequisites: MATH 448 (may be taken concurrently)

Course Notes: or ACSC 348 or MATH 348.

**MATH 477 - SURVIVAL MODELS**

Survival data, survival functions, hazard functions, life tables, comparing two groups of survival data, parametric models of survival data, and sample size for survival studies.

Credits: 3

Prerequisites: ACSC 348 (may be taken concurrently) or MATH 348 (may be taken concurrently) or MATH 448 (may be taken concurrently)

Course Notes: or concurrent

**MATH 478 - TOPICS IN ACTUARIAL MATH**

Course content varies. Topics in actuarial models and actuarial modeling. May be repeated for credit for up to six semester hours.

Credits: 3

Course Notes: Consent of instructor.

**MATH 480FM - ACTUARIAL SCIENCE SEMINAR**

Preparation for the Society of Actuaries Exam FM and the Casualty Actuarial Society Exam 2.

Credits: 3

Course Notes: MATH 367

**MATH 480P - ACTUARIAL SCI SEM: EXAM P/1**

Preparation for the Society of Actuaries Exam P and the Casualty Actuarial Society Exam 1.

Credits: 3

Prerequisites: MATH 448 (may be taken concurrently)

Course Notes: MATH 347

**MATH 488 - SPECIAL TOPICS**

Course content varies. May be repeated for up to nine semester hours. This topics course may not be cross-listed with undergraduate coursework.

Credits: 1-3

Course Notes: Prerequisites vary by topics.

**MATH 489 - SPECIAL TOPICS**

Course content varies. May be repeated for up to nine semester hours.

Credits: 1,3

**MATH 490 - MASTER'S THESIS**

Individual projects pursued under an instructor's supervision.

Credits: 3

**MATH 495 - INDEPENDENT STUDY**

Individual projects pursued under an instructor's supervision.

Credits: 1-6

Course Notes: Consent of instructor