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 classification techniques, clustering 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 411 - 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 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 Itôparity 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: 3

MATH 490 - MASTER'S THESIS
Individual projects pursued under an instructor's supervision.
Credits: 3

MATH 491 - INDUSTRIAL APP OF MATH
Students work on a semester long research project solving a real world problem from industry using various methods of mathematical modeling. Problems vary by semester.
Credits: 3
Course Notes: Open to graduate students in Mathematics, Actuarial Science, or related fields.

MATH 495 - INDEPENDENT STUDY
Individual projects pursued under an instructor's supervision.
Credits: 1-6
Course Notes: Consent of instructor.