Mathematics - MATH

Courses

MATH 1000 COLLEGE ALGEBRA (3) LEC. 3. Fundamental concepts of algebra, equations and inequalities, functions and graphs, polynomial and rational functions. Does not satisfy the core requirement in mathematics. Students who have previous credit in any higher-numbered math course may not also receive credit for this course.

MATH 1100 FINITE MATH AND APPLICATIONS (3) LEC. 3. Pr. A02 score of 22 or S02 score of 520 or S12 score of 550 or MATH 1000 or MATH 1003 or MPME score of 052 or ALEK score of 050. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. Mathematics Core. Overview of finite mathematics and its applications. Graph theory, matrices, finite and conditional probability; descriptive and inferential statistics, voting methods, game theory.

MATH 1120 PRE-CALCULUS ALGEBRA (3) LEC. 3. Pr. A02 score of 22 or S02 score of 520 or S12 score of 550 or MATH 1000 or MATH 1003 or MPME score of 052 or ALEK score of 050. Mathematics Core. Preparatory course for calculus. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. This course emphasizes the algebra of functions – including polynomial, rational, exponential, and logarithmic functions. In addition, the course covers non-linear inequalities as well as systems of linear and non-linear equations and inequalities. The course also includes an introduction to sequences and series. No credit is given to students with higher-numbered math course. Credit for only one of MATH 1120/MATH 1123.

MATH 1121 PRE-CALCULUS ALGEBRA WORKSHOP (1) LAB. 1. SU. Coreq. MATH 1123 and MATH 1003 and MATH 1000 and MATH 1120. Workshop for College Algebra and Pre-Calculus Algebra.

MATH 1130 PRE-CALCULUS TRIGONOMETRY (3) LEC. 3. Pr. A02 score of 23 or S02 score of 540 or S12 score of 565 or MATH 1120 or MATH 1123 or MPME score of 060 or ALEK score of 064. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. Mathematics Core. Preparatory course for the calculus sequence. Basic analytic and geometric properties of the trigonometric functions. Complex numbers, De Moivre' Theorem, polar coordinates. Students who have previous credit in any higher-numbered math course may not also receive credit for this course. Students may receive credit for only one of MATH 1130/MATH 1133.

MATH 1150 PRE-CALCULUS ALGEBRA AND TRIGONOMETRY (4) LEC. 4. Pr. A02 score of 23 or S02 score of 540 or S12 score of 565 or MATH 1000 or MATH 1003 or MPME score of 060 or ALEK score of 064. "C" or better in MATH 1000 or MATH 1003. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. Mathematics Core. Algebraic functions, Exponential Logarithmic functions. Analytic and geometric properties of trigonometric functions. Students with previous credit in any higher-numbered math course may not also receive credit for this course.

MATH 1151 MATHEXCEL PRECALCULUS WORKSHOP (2) LEC. 2. SU. Coreq. MATH 1150. Appropriate score on the mathematics placement exam or grade of "C" or better in MATH 1000. Workshop for MATH 1150. Two 2-hour sessions per week.

MATH 1610 CALCULUS I (4) LEC. 4. Pr. A02 score of 30 or S02 score of 600 or S12 score of 700 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MPME score of 076 or ALEK score of 078. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. "C" or better in MATH 1130/1133, MATH 1150/1153. Mathematics Core. Limits, the derivative of algebraic, trigonometric, exponential, logarithmic functions. Applications of the derivative, antiderivatives, the definite integral and applications to area problems, the fundamental theorem of calculus. Students may receive credit for only one of MATH 1610/1613/1617.

MATH 1617 HONORS CALCULUS I (4) LEC. 4. Pr. A02 score of 30 or S02 score of 600 or S12 score of 700 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MPME score of 076 or ALEK score of 078. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. "C" or better in MATH 1130, MATH 1133, MATH 1150 or MATH 1153. Mathematics Core. Honors version of MATH 1610. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). This course covers the same material as MATH 1610 but in a greater depth appropriate for Honors students and Mathematics majors. Students may receive credit for only one of the following: MATH 1610, MATH 1613, MATH 1617 or MATH 1680.

MATH 1620 CALCULUS II (4) LEC. 4. Pr. MATH 1610 or MATH 1613 or MATH 1617. "C" or better in MATH 1610, MATH 1613, or MATH 1617. Techniques of integration, applications of the integral, parametric equations, polar coordinates. Vectors, lines and planes in space. Infinite sequences and series. Students may receive credit for only one of MATH 1620, MATH 1627, or MATH 1720.

MATH 1627 HONORS CALCULUS II (4) LEC. 4. Pr. Honors College. MATH 1610 or MATH 1617 or MATH 1613. "C" or better in MATH 1610, MATH 1613, or MATH 1617. Honors version of MATH 1620. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). The same material as MATH 1620, but in greater depth appropriate for honors students and Mathematics majors. Students may receive credit for only one of MATH 1620 or MATH 1627.

MATH 1680 CALCULUS WITH BUSINESS APPLICATIONS I (4) LEC. 4. Pr. A02 score of 25 or S02 score of 580 or S12 score of 600 or MATH 1120 or MATH 1123 or MATH 1130 or MATH 1133 or MATH 1150 or MATH 1153 or MPME score of 068 or ALEK score of 068. A02 refers to the ACT MATH score; S02 refers to the SAT MATH score taken between 2005- January 2016; S12 refers to the SAT MATH score taken between March 2016-present. ALEK refers to ALEKS Math Placement Test for students enrolled Fall 2021 to present. Students in College of Business. Mathematics Core. Differentiation and integration of exponential and logarithmic functions, applications to business. Functions of several variables, partial derivatives, multiple integrals.

MATH 1690 CALCULUS WITH BUSINESS APPS II (3) LEC. 3. Pr. MATH 1680 or MATH 1683 or MATH 1610 or MATH 1617 or MATH 1613. Probability, random variables, probability distributions. Further topics in calculus: integration, functions of several variables, applications to probability. Applications to business and related areas. Credit will not be given to majors in Engineering or Math or Physics.

MATH 1950 FIRST YEAR MATHEMATICS SEMINAR (1) SEM. 1. This seminar will provide a shared intellectual experience for incoming freshmen mathematics majors. It will serve as a focused and interactive forum to provide a glimpse into the world of mathematics that lies beyond elementary calculus. Each semester's symposium will be devoted to a specific mathematical topic. Writing about mathematics and explaining mathematical ideas to both “math people” and “non-math people” will be emphasized. Only offered to incoming first-year students (though transfer students and higher rank students may be allowed to enroll on an approval basis). May not be repeated for credit. High School Math will be required.

MATH 2630 CALCULUS III (4) LEC. 4. Pr. MATH 1620 or MATH 1623 or MATH 1627. "C" or better in MATH 1620, MATH 1623 or MATH 1627. Multivariate calculus: vector-valued functions, partial derivatives, multiple integration, vector calculus. Credit will be given for only MATH 2630 or MATH 2637.

MATH 2637 HONORS CALCULUS III (4) LEC. 4. Pr. MATH 1620 or MATH 1623 or MATH 1627. Must have earned a "C" or better in MATH 1620, MATH 1623 or MATH 1627. Honors version of MATH 2630. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). The same material as MATH 2630, but in greater depth appropriate for honors students and Mathematics majors. Credit will be given for only one of MATH 2630 or MATH 2633 or MATH 2637.

MATH 2650 LINEAR DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. P/C MATH 2630 or P/C MATH 2633 or P/C MATH 2637. Introduction to ordinary differential equations, specifically linear equations of first and second order, and applications.

MATH 2660 TOPICS IN LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Matrices, row-reduction, systems of linear equations, (finite-dimensional) vector spaces, subspaces, bases, dimension, change of basis, linear transformations, kernels, orthogonality, Gram-Schmidt.

MATH 2667 HONORS TOPICS IN LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Must have earned a "C" or better in MATH 1620 or MATH 1623 or MATH 1627. Honors version of MATH 2660. Membership in the Honors College or Departmental approval required. Recommended for all Mathematics majors: (Applied Math-Actuarial Sci(ACTU), Applied Math-Discrete(DISC), Applied Mathematics(AMTH), and Mathematics(MATH). Topics include: matrices, row-reduction, systems of linear equations, (finite-dimensional) vector spaces, subspaces, bases, dimension, change of basis, linear transformations, kernels, orthogonality, Gram-Schmidt. The same material as MATH 2660, but in greater depth appropriate for honors students and Mathematics majors, with possible additional topics as determined by the instructor. Credit will be given for only one of MATH 2660 or MATH 2667.

MATH 2670 INTRODUCTION TO DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. MATH 1620. Rigorous introduction to ordinary differential equations with emphasis on mathematical justification of solution methods and qualitative analysis of equations and low dimensional systems. The existence and uniqueness theorems. Separable equations, exact equations and integrating factors. Second order linear equations, the Wronskian, method of undetermined coefficients, variation of parameters. Laplace transform. Higher order equations. Systems of first order equations, fundamental matrix.

MATH 2790 MATHEMATICS OF INTEREST THEORY (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. Mathematical foundations of the theory of interest necessary as preparation for the Society of Actuaries examination on the theory of interest.

MATH 2850 MATHEMATICS FOR ELEMENTARY EDUCATION I (3) LEC. 3. For Elementary Education major or departmental approval. Mathematical insights for elementary school teachers. Sets, the structure of the number system (integers, fraction, decimals).

MATH 2860 MATHEMATICS FOR ELEMENTARY EDUCATION II (3) LEC. 3. Pr. MATH 2850. For Elementary Education majors or departmental approval. Mathematical insights into measurement and geometry for elementary school teachers. Shapes in two and three dimensions. Similarities, congruences and transformations.

MATH 2870 MATHEMATICS FOR ELEMENTARY EDUCATION III (3) LEC. 3. For Elementary Education majors or departmental approval. Mathematical insights into probability, data analysis and functions for elementary school teachers. Uncertainty, probability spaces and an introduction to statistics. Relationships, functions and change.

MATH 3010 HISTORY OF MATHEMATICS (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627. The evolution of modern mathematics from its motivational roots in the physical sciences; the lives and contributions of outstanding mathematicians; the parallel development of mathematics and western culture.

MATH 3100 INTRODUCTION TO ADVANCED MATHEMATICS (3) LEC. 3. Pr. MATH 2630 or MATH 2637. Teaching of the fundamental abilities necessary for the pursuance of mathematical studies. Logic and set theory, mathematical induction, basic number theory, basic analysis. Credit will not be given for both MATH 3100 and Math 3710.

MATH 3710 DISCRETE MATHEMATICS (3) LEC. 3. Pr. MATH 2660. Methods of proof, induction, counting, inclusion-exclusion, discrete probability, relations, partial orders, graphs, trees, languages, grammars, finite state machines, automata. Credit will not be given for both MATH 3710 and Math 3100.

MATH 4110 ADVANCED LOGIC (3) LEC. 3. Pr. MATH 2630 or MATH 2637 and MATH 2730. Advanced topics in logic. For example: soundness, completeness, incompleteness, set theory, proof theory, model theory, non-standard logics. May count either MATH 4110 or PHIL 4110.

MATH 4790 ACTUARIAL SEMINAR IN THE MATHEMATICS OF FINANCE (3) LEC. 3. Pr. MATH 2790. Intensive seminar in the mathematical aspects of finance, and the theory of interest primarily intended as preparation for the Society of Actuaries Course 2 examination.

MATH 4820 ACTUARIAL SEMINAR IN PROBABILITY (3) LEC. 3. Pr. STAT 3600. or equivalent. Intensive seminar in calculus, probability, and risk theory primarily intended as preparation for the Society of Actuaries Course 1 examination.

MATH 4930 DIRECTED STUDIES (1-3) IND. Study of individual problems or topics of interest to students. Course may be repeated for a maximum of 3 credit hours.

MATH 4970 SPECIAL TOPICS (1-4) IND. Departmental approval. An individual problems course. Each student will work under the direction of a staff member on a problem of mutual interest. Course may be repeated for a maximum of 4 credit hours.

MATH 4980 UNDERGRADUATE RESEARCH (1-3) IND. Departmental approval. Directed research in the area of specialty under faculty supervison. Course may be repeated for a maximum of 3 credit hours.

MATH 4997 HONORS THESIS (1-6) IND. Pr. Honors College. Course may be repeated for a maximum of 6 credit hours. Membership in Honors College.

MATH 5000 MATH MODELING CONTINUOUS (3) LEC. 3. Pr. MATH 2650 and MATH 2660. Introduction to mathematical models and related techniques. Includes general principles involving continuous deterministic problems and a detailed, specific term project. Programming ability.

MATH 5010 VECTOR CALCULUS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637 or MATH 2730) and MATH 2660. Departmental approval. Vector-valued functions, vector fields. Gradient, divergence, curl. Integral theorems: Green's Theorem, Stoke's Theorem, Gauss' Theorem. Tensors and differential forms. Applications.

MATH 5030 COMPLEX VARIABLES WITH APPLICATIONS I (3) LEC. 3. Pr. MATH 2650. Complex functions and their elementary mapping properties; contour integration and residues; Laurent series; applications to real integrals. MATH 5030-5040 are appropriate for students of engineering or science.

MATH 5040 COMPLEX VARIABLES WITH APPLICATIONS II (3) LEC. 3. Pr. MATH 5030. Linear fractional transformations; conformal mappings; harmonic functions; applications to boundary value problems; analytic continuation; entire functions. MATH 5030-5040 are appropriate for students of engineering or science.

MATH 5050 MATRIX THEORY AND APPLICATIONS (3) LEC. 3. Pr. MATH 2660. Canonical forms, determinants, linear equations, eigenvalue problems.

MATH 5060 ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (3) LEC. 3. Pr. MATH 2650. First and second order linear partial differential equations with emphasis on the method of eigenfunction expansions.

MATH 5110 NUMBER THEORY (3) LEC. 3. Pr. MATH 3100. Greatest common divisor, unique factorization, linear Diophantine equations. Modular arithmetic, Chinese remainder theorem, polynomial congruences. Quadratic residues, Legendre/Jacoby symbols, quadratic reciprocity. Primes. Moebius inversion. Sums of squares. Units and the integers mod n.

MATH 5120 INFORMATION THEORY (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Information and entropy, information rate optimization and channel capacity, variable-length codes, data compression (Kraft-McMillan inequality, Huffman's algorithm), maximum likelihood decoding, Shannon's Noisy Channel Theorem.

MATH 5130 CALCULUS OF VARIATION (3) LEC. 3. Pr. MATH 2650. Fundamental concepts of extrema of functions and functionals; first and second variations; generalizations; sufficient conditions; constrained functionals; the general Lagrange Problem; optimal control.

MATH 5140 DATA COMPRESSION (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627 or MATH 1720. Lossless compression methods, including static, dynamic, and higher order Huffman and arithmetic encoding, interval and recency rank encoding, and dictionary methods; lossy transform methods (JPEG).

MATH 5150 ALGEBRAIC CODING THEORY (3) LEC. 3. Pr. MATH 2660. Linear codes, Hamming and Golay codes, BCH codes, cyclic codes. Random error detection and correction. Burst-error correction. Decoding algorithms. Credit will not be given for both MATH 5150 and MATH 6150/6156.

MATH 5170 FINITE EXTREMAL SET THEORY (3) LEC. 3. Pr. (MATH 2660 or MATH 2667) and (MATH 3100 or MATH 3710). Finite posets and their Hasse diagrams. Sequences and the Erdos-Szekeres Theorem. Chains and antichains, Dilworth's Theorem. Set systems in the hypercube, Sperner's Lemma and the LYM inequality. Intersecting families, the Erdos-Ko-Rado Theorem. Isoperimetric inequalities in the hypercube. Additional topics related to recent research. Includes paper reading and presentation component.

MATH 5180 CRYPTOGRAPHY (3) LEC. 3. Pr. MATH 2660. Classical cryptosystems, the Data Encryption Standard, one-way functions and relevant number theoretic problems (factoring, primality testing, discrete logarithm problem), RSA and other public key cryptosystems.

MATH 5200 ANALYSIS I (3) LEC. 3. Pr. MATH 3100. "C" or better in MATH 3100. Real numbers, infima and suprema; sequences and series of real numbers, convergence and limits, cauchy sequences and completeness; topology of the real line, Bolzano-Weierstrass and Heine-Borel theorems; real-valued functions of a real variable, continuity and uniform continuity. Emphasis on proofs.

MATH 5210 ANALYSIS II (3) LEC. 3. Pr. MATH 5200. Sequences and series of functions, modes of convergence, power series, elementary functions; derivatives and antiderivatives, the mean-value theorem; Riemann integration and the Fundamental Theorem of Calculus; R^n and abstract spaces, functions of several variables. Emphasis on proofs.

MATH 5280 SYSTEMS OF DIFFERENTIAL EQUATIONS AND APPLICATIONS (3) LEC. 3. Pr. MATH 2650 and MATH 2660. Linear systems of differential equations, stability, phase portraits; non-linear systems, linearization, qualitative properties of orbits, Poincare-Bendixson Theorem; numerical methods; applications.

MATH 5300 THEORY OF DIFFERENCE EQUATIONS (3) LEC. 3. Pr. MATH 2660. Linear difference equations, initial value problems, Green's functions, boundary value problems, systems, periodic solutions, nonlinear difference equations, models.

MATH 5310 INTRODUCTION TO ABSTRACT ALGEBRA I (3) LEC. 3. Pr. MATH 3100. "C" or better in MATH 3100. Groups, Groups of Permutations, isomorphisms and homomorphisms; Cyclic Groups, Quotient Groups, The Fundamental Homomorphism Theorem.

MATH 5320 INTRODUCTION TO ABSTRACT ALGEBRA II (3) LEC. 3. Pr. MATH 5310. Theory of rings and fields, Ideals and Homomorphisms, Quotient Rings, Rings of Polynomials, Extensions of Fields, Galois Theory.

MATH 5330 COMPUTATIONAL ALGEBRA (3) LEC. 3. Pr. MATH 5310. Introduction to computation in multivariate polynomial rings and finite fields. Topics include Groebner bases, Buchberger's Algorithm, kinematic/robotics problems, symbolic manipulation software.

MATH 5350 INTRODUCTION TO ALGEBRAIC GEOMETRY (3) LEC. 3. Pr. MATH 5320. LEC. 3. Pr. "C" or better in Math 5320. Affine varieties, Hilbert's Nullstellensatz, the Ideal-Variety Correspondence, irreducibility, polynomial and rational functions, projective varieties, Bezout's Theorem, dimension theory.

MATH 5370 LINEAR ALGEBRA (3) LEC. 3. Pr. MATH 2660. Introduction to the theoretical foundations of Linear Algebra including vector spaces, basis, dimension, linear transformations, fundamental subspaces, matrix representations, eigenvalues, eigenspaces.

MATH 5380 INTERMEDIATE EUCLIDEAN GEOMETRY I (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Fundamental concepts and theorems of Euclidean geometry, introduction to higher dimensions. Regular polygons and polyhedra, symmetry groups, convexity, geometric extremum problems. Geometric transformations and their invariants.

MATH 5390 INTERMEDIATE EUCLIDEAN GEOMETRY II (3) LEC. 3. Pr. MATH 5380. Planar graphs and Euler's theorem. The symmetry group of a set, homotheties and similitudes, path, arcs and length of curves, advanced theorems on the circle.

MATH 5460 PERTURBATION METHODS (3) LEC. 3. Pr. MATH 2650. Analytical solutions of nonlinear problems, ODEs, PDEs, multiple scales, and transcendental equations in engineering, mathematics, and physics using both regular and singular perturbation methods.

MATH 5500 INTRODUCTION TO TOPOLOGY (3) LEC. 3. Pr. MATH 3100. C or better in MATH 3100. Metric spaces, topological spaces, continuity, compactness, connectedness, product and quotient spaces and local properties.

MATH 5630 INTRODUCTION TO NUMERICAL ANALYSIS I (3) LEC. 3. Pr. MATH 2650. Programming ability. Numerical solution of equations, polynomial approximation, numerical differentiation and integration, numerical solutions of ordinary differential equations, error analysis. Written programs using algorithms. Programming ability.

MATH 5640 INTRODUCTION TO NUMERICAL ANALYSIS II (3) LEC. 3. Pr. MATH 2660. Programming ability. Numerical solutions of systems of linear equations, numerical computation of eigenvalues and eigen vectors, error analysis. Written programs using the algorithms.

MATH 5650 THEORY OF NONLINEAR OPTIMIZATION (3) LEC. 3. Pr. MATH 2650 and MATH 2660. Kuhn-Tucker conditions, quadratic programming, search methods and gradient methods, Lagrangean and penalty function methods.

MATH 5670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both MATH 5670 and STAT 5670.

MATH 5680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. MATH 5670 or STAT 5670. Multivariate distributions. Central Limit Theorem, Laplace transforms, convolutions, simulation, renewal processes, Continuous-time Markov Chains, Markov renewal and semi-regenerative processes, Brownian motion and diffusion. Credit will not be given for both MATH 5680 and STAT 5680.

MATH 5710 LINEAR OPTIMIZATION (3) LEC. 3. Pr. MATH 2660. Theory and algorithms for standard linear optimization problems. Simplex algorithm and duality, shortest paths, network flows, min-cost flows and circulations, out-of-kilter method, assignments and matchings.

MATH 5730 ENUMERATION (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Using generating functions and Polya theory to do sophisticated counting. Permutations and combinations, inclusion-exclusion, partitions, recurrence relations, group actions, Polya theory with applications.

MATH 5750 INTRODUCTION TO GRAPH THEORY (3) LEC. 3. Pr. MATH 2660. Algorithmic and theoretical aspects of graph theory: matchings, colorings, scheduling problems, Hamilton cycles. Euler tours, spanning trees, network reliability, connectivity, extremal graphs, planar graphs, disjoint paths.

MATH 5770 COMBINATORIAL DESIGNS (3) LEC. 3. Pr. MATH 1620 or MATH 1623 or MATH 1627 or MATH 1720. Latin squares, mutually orthogonal latin squares, orthogonal and perpendicular arrays, Steiner triple systems, block designs, difference sets and finite geometries.

MATH 5800 ACTUARIAL MATHEMATICS I (3) LEC. 3. Pr. MATH 2790 and STAT 3600. A development of the mathematical theory of life insurance and annuities. Utility functions, mortality models, life tables, insurance plans, premiums.

MATH 5810 ACTUARIAL MATHEMATICS II (3) LEC. 3. Pr. MATH 5800. A development of the mathematical theory of life insurance and annuities. Utility functions, mortality models, life tables, insurance plans, premiums.

MATH 5840 FOUNDATIONS OF NUMBER THEORY FOR SECONDARY SCHOOL TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. Divisibility, Diophantine equations, congruencies.

MATH 5850 NUMERICAL ANALYSIS FOR SECONDARY TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. The numerical solutions of selected problems arising in calculus and algebra along with the programming techniques. Computer familiarity.

MATH 5860 FOUNDATIONS OF NON-EUCLIDEAN GEOMETRY FOR SECONDARY SCHOOL TEACHERS (3) LEC. 3. Pr. MATH 2630 or MATH 2637 or MATH 2730. B.L. geometry, hyperbolic geometry, absolute geometry, parallel postulates.

MATH 5870 FINANCIAL MATHEMATICS (3) LEC. 3. Pr. (MATH 1610 or MATH 1613 or MATH 1617) and (MATH 1620 or MATH 1623 or MATH 1627) and MATH 2650 and STAT 3600. Options and spreads, pricing of such options in accordance with the Black-Scholes Equation, and the binomial pricing model.

MATH 5970 SPECIAL TOPICS (1-3) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 3 credit hours.

MATH 6000 MATHEMATICAL MODELING: CONTINUOUS (3) LEC. 3. Introduction to mathematical models and related techniques. Includes general principles involving continuous deterministic problems and a detailed, specific term-project. Programming ability.

MATH 6010 VECTOR CALCULUS (3) LEC. 3. Pr. (MATH 2630 or MATH 2637) and MATH 2660. Departmental approval. Vector-valued functions, vector fields. Gradient, divergence, curl. Integral theorems: Green's Theorem, Stoke's Theorem, Gauss' Theorem. Tensors and differential forms. Applications.

MATH 6030 COMPLEX VARIABLES WITH APPLICATIONS I (3) LEC. 3. Complex functions and their elementary mapping properties; contour integration and residues; Laurent series; applications to real integrals. MATH 6030-6040 are appropriate for students of engineering or science.

MATH 6050 MATRIX THEORY AND APPLICATIONS (3) LEC. 3. Canonical forms, determinants, linear equations, eigenvalue problems.

MATH 6060 ELEMENTARY PARTIAL DIFFERENTIAL EQUATIONS (3) LEC. 3. First and second order linear partial differential equations with emphasis on the method of eigenfunction expansions.

MATH 6110 NUMBER THEORY (3) LEC. 3. Greatest common divisor, unique factorization, linear Diophantine equations. Modular arithmetic, Chinese remainder theorem, polynomial congruences. Quadratic residues, Legendre/Jacoby symbols, quadratic reciprocity. Primes. Moebius inversion. Sums of squares. Units and the integers mod n.

MATH 6120 INFORMATION THEORY (3) LEC. 3. Information and entropy, information rate optimization and channel capacity, variable-length codes, data compression (Kraft-McMillan inequality, Huffman's algorithm), maximum likelihood decoding, Shannon's Noisy Channel Theorem.

MATH 6140 DATA COMPRESSION (3) LEC. 3. Lossless compression methods, including static, dynamic, and higher order Huffman and arithmetic encoding, interval and recency rank encoding, and dictionary methods; lossy transform methods (JPEG).

MATH 6150 ALGEBRAIC CODING THEORY (3) LEC. 3. Pr. MATH 2660. Linear codes, Hamming and Golay codes, BCH codes, cyclic codes. Random error detection and correction. Burst-error correction. Decoding algorithms. Credit will not be given for both MATH 5150 and MATH 6150/6156.

MATH 6170 FINITE EXTREMAL SET THEORY (3) LEC. 3. Pr. (MATH 2660 or MATH 2667) and (MATH 3100 or MATH 3710). Finite posets and their Hasse diagrams. Sequences and the Erdos-Szekeres Theorem. Chains and antichains, Dilworth's Theorem. Set systems in the hypercube, Sperner's Lemma and the LYM inequality. Intersecting families, the Erdos-Ko-Rado Theorem. Isoperimetric inequalities in the hypercube. Additional topics related to recent research. Includes paper reading and presentation component. Graduate version of MATH 5170.

MATH 6180 CRYPTOGRAPHY (3) LEC. 3. Classical cryptosystems, the Data Encryption Standard, one-way functions and relevant number theoretic problems (factoring, primality testing, discrete logarithm problem), RSA and other public key cryptosystems.

MATH 6200 ANALYSIS I (3) LEC. 3. or equivalent course, subject to departmental approval. Real numbers, infima and suprema; sequences and series of real numbers, convergence and limits, Cauchy sequences and completeness; topology of the real line, Bolzano-Weierstrass and Heine-Borel theorems; real-valued functions of a real variable, continuity and uniform continuity; intermediate#value and extreme-value theorems. Emphasis on proofs.

MATH 6210 ANALYSIS II (3) LEC. 3. Pr. MATH 6200. Sequences and series of functions, modes of convergence, power series, elementary functions; derivatives and power series, elementary functions; derivatives and antiderivatives, the mean-value theorem; Riemann integration and the Fundamental Theorem of Calculus; R^n and abstract spaces, functions of several variables. Emphasis on proofs.

MATH 6310 INTRODUCTION TO ABSTRACT ALGEBRA I (3) LEC. 3. Departmental approval. Groups, Groups of Permutations, isomorphisms and homomorphisms; Cyclic Groups, Quotient Groups, The Fundamental Homomorphism Theorem.

MATH 6320 INTRODUCTION TO ABSTRACT ALGEBRA II (3) LEC. 3. Pr. MATH 6310. Theory of rings and fields, Ideals and Homomorphisms, Quotient Rings, Rings of Polynomials, Extensions of Fields, and Galois Theory.

MATH 6330 COMPUTATIONAL ALGEBRA (3) LEC. 3. Pr. MATH 6310. Introduction to computation in multivariate polynomial rings and finite fields. Topics include Groebner bases, Buchberger's Algorithm, kinematic/robotics problems, and symbolic manipulation software.

MATH 6350 INTRODUCTION TO ALGEBRAIC GEOMETRY (3) LEC. 3. Pr. MATH 5320. LEC. 3. Pr. "C" or better in Math 5320. Affine varieties, Hilbert's Nullstellensatz, the Ideal-Variety Correspondence, irreducibility, polynomial and rational functions, projective varieties, Bezout's Theorem, dimension theory.

MATH 6370 LINEAR ALGEBRA (3) LEC. 3. Introduction to the theoretical foundations of Linear Algebra Algebra including vector spaces, basis, dimension, linear transformations, fundamental subspaces matrix representations, eigenvalues, eigenspaces.

MATH 6380 INTERMEDIATE EUCLIDEAN GEOMETRY I (3) LEC. 3. Fundamental concepts and theorems of Euclidean geometry, introduction to higher dimensions. Regular polygons and polyhedra, symmetry groups, convexity, geometric extremum problems. Geometric transformations and their invariants.

MATH 6390 INTERMEDIATE EUCLIDEAN GEOMETRY II (3) LEC. 3. Pr. MATH 6380. Planar graphs and Euler's theorem. The symmetry group of a set, homotheties and similitudes, path, arcs and length of curves, and advanced theorems on the circle.

MATH 6460 PERTURBATION METHODS (3) LEC. 3. Pr. MATH 2660. Departmental approval. Analytical solutions of nonlinear problems, ODES, PDEs, multiple scales, and transcendental equations in engineering, mathematics, and physics using both regular and singular perturbation methods. May count either AERO/MATH 5460 or AERO/MATH 6460.

MATH 6500 INTRODUCTION TO TOPOLOGY (3) LEC. 3. Departmental approval. Metric spaces, topological spaces, continuity, compactness, connectedness, product and quotient spaces and local properties.

MATH 6630 INTRODUCTION TO NUMERICAL ANALYSIS I (3) LEC. 3. Numerical solution of equations, polynomial approximation, numerical differentiation and integration, numerical solutions of ordinary differential equations, error analysis. Written programs using algorithms. Programming ability.

MATH 6640 INTRODUCTION TO NUMERICAL ANALYSIS II (3) LEC. 3. Numerical solutions of systems of linear equations, numerical computation of eigenvalues and eigenvectors, error analysis. Written programs using the algorithms. Programming ability.

MATH 6650 THEORY OF NONLINEAR OPTIMIZATION (3) LEC. 3. Kuhn-Tucker conditions, quadratic programming, search methods and gradient methods, Lagrangean and penalty function methods.

MATH 6670 PROBABILITY AND STOCHASTIC PROCESSES I (3) LEC. 3. Random variables, discrete and absolutely continuous distributions. Poisson process, expectation and conditional expectation. Moment generating functions, limit distributions. Emphasis on probabilistic reasoning and problem solving. Credit will not be given for both MATH 6670 and STAT 6670.

MATH 6680 PROBABILITY AND STOCHASTIC PROCESSES II (3) LEC. 3. Pr. MATH 6670 or MATH 6676 or STAT 6670 or STAT 6676. Multivariate distributions. Central Limit Theorem, Laplace transforms, convolutions, simulation, renewal processes, Continuous-time Markov Chains, Markov renewal and semi- regenerative processes, Brownian motion and diffusion. Credit will not be given for both MATH 6680 and STAT 6680.

MATH 6710 LINEAR OPTIMIZATION (3) LEC. 3. Theory and algorithms for standard linear optimization problems. Simplex algorithm and duality, shortest paths, network flows, min-cost flows and circulations, out-of-kilter method, assignments and matchings.

MATH 6730 ENUMERATION (3) LEC. 3. Using generating functions and Polya theory to do sophisticated counting. Permutations and combinations, inclusion-exclusion, partitions, recurrence relations, group actions, Polya theory with applications.

MATH 6750 INTRODUCTION TO GRAPH THEORY (3) LEC. 3. Algorithmic and theoretical aspects of graph theory: matchings, colorings, scheduling problems, Hamilton cycles. Euler tours, spanning trees, network reliability, connectivity, extremal graphs, planar graphs, disjoint paths.

MATH 6770 COMBINATORIAL DESIGNS (3) LEC. 3. Latin squares, mutually orthogonal latin squares, orthogonal and perpendicular arrays, Steiner triple systems, block designs, difference sets and finite geometries.

MATH 6800 ACTUARIAL MATHEMATICS I (3) LEC. 3. Departmental approval. A development of the mathematical theory of life insurance and annuities. Utility functions, mortality models, life tables, insurance plans, premiums.

MATH 6810 ACTUARIAL MATHEMATICS II (3) LEC. 3. Pr. MATH 6800. A development of the mathematical theory of life insurance and annuities. Utility functions, mortality models, life tables, insurance plans, premiums.

MATH 6840 NUMBER SYSTEMS AND ALGEBRA FOR TEACHERS (3) LEC. 3. Pr. MATH 3100. Connections of advanced college-level mathematics with the secondary mathematics curriculum, focusing on number systems, algebra, and functions, to develop mathematical knowledge relevant to teaching. Includes appropriate uses of technology and non-routine mathematics problem solving. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6850 FUNCTIONS AND MATHEMATICAL MODELING FOR TEACHERS (3) LEC. 3. Pr. MATH 2650 or MATH 2660 or MATH 2667. Connections of advanced college-level mathematics with the secondary mathematics curriculum, focusing on functions and mathematical modeling, to develop mathematical knowledge relevant to teaching. Includes appropriate uses of technology and non-routine mathematics problem solving. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6860 GEOMETRY FOR TEACHERS (3) LEC. 3. Pr. MATH 2660 or MATH 2667 or MATH 3100. Connect advanced college-level mathematics with the secondary mathematics curriculum, focusing on geometry, to develop mathematical knowledge relevant to teaching. The contents include axiomatic systems of geometry, transformational geometry, and similarity. Appropriate technology and mathematics problem solving skills will be introduced. Admission to a program in Secondary Mathematics Education or department approval required.

MATH 6870 FINANCIAL MATHEMATICS (3) LEC. 3. Pr. (MATH 1610 or MATH 1613 or MATH 1617) and (MATH 1620 or MATH 1623 or MATH 1627) and MATH 2650 and STAT 3600. Options and spreads, pricing of such options in accordance with the Black-Scholes Equation, and the binomial pricing model.

MATH 6970 SPECIAL TOPICS (1-3) DSL. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 3 credit hours.

MATH 7000 APPLIED MATHEMATICS I (3) LEC. 3. Departmental approval. Linear spaces, matrices, eigenvalues, least squares solutions to linear systems, Hilbert spaces, orthogonal expansions, integral equations, compact operators, Green's functions for boundary value problems, eigenfunction expansions.

MATH 7010 APPLIED MATHEMATICS II (3) LEC. 3. Pr. MATH 7000 or MATH 7006. Calculus of variations, asymptotic expansions, Spectral theory, Fourier transform, Partial differential equations, transform methods and eigenfunction expansions, vibrations, diffusion processes, equilibrium states, Green's functions, boundary layer problems.

MATH 7110 DISCRETE GEOMETRY AND CONVEXITY I (3) LEC. 3. Departmental approval. Geometric objects and configurations with discrete symmetry groups. Regular polygons and polyhedra. Regular arrangements. Plane tilings and patterns.

MATH 7120 DISCRETE GEOMETRY AND CONVEXITY II (3) LEC. 3. Pr. MATH 7110. Convexity and related geometric extremum problems. Packing and covering. Arrangements of extreme density.

MATH 7140 INTRODUCTION TO MODEL THEORY (3) LEC. 3. Departmental approval. First-order languages, Satisfaction. Consequences. The completeness and compactness theorems, models constructed from constants. Elementary substructures and embeddings, Lowenheim-Skolem-Tarskj theorems. Ultraproducts and ultrapowers.

MATH 7150 AXIOMATIC SET THEORY I (3) LEC. 3. Departmental approval. Introduction to modern set theory. The axioms of ZFC, ordinals and cardinals, closed unbounded sets, the constructible universe L, Martin's Axiom.

MATH 7160 AXIOMATIC SET THEORY II (3) LEC. 3. Pr. MATH 7150. Introduction to forcing, independence results, iterated forcing, consistency of Martin's Axiom.

MATH 7180 ALGORITHMIC ALGEBRA I (3) LEC. 3. Departmental approval. Fundamental aspects of algorithmic algebra. Noetherian rings. Theory of Groebner bases. Hilbert Nullstellensatz. Elimination theory. Applications to graph theory and algebraic geometry.

MATH 7190 ALGORITHMIC ALGEBRA II (3) LEC. 3. Pr. MATH 7180. Modules. Groebner bases for modules and syzygy computations. Improved Buchberger's algorithm. Computation of Ext. Groebner bases over rings. Primary decomposition of ideals. Dimension theory.

MATH 7200 REAL ANALYSIS I (3) LEC. 3. Departmental approval. Sigma algebras, measures, measurable functions, integratability, properties of Lebesgue measure, density, Lusin's theorem, Egeroff's theorem, product measures, Fubini's theorem. Limit theorems involving pointwise convergence and integration.

MATH 7210 REAL ANALYSIS II (3) LEC. 3. Pr. MATH 7200. L-p spaces, completeness, duals. Weak convergence, norm convergence, pointwise convergence, convergence in measure. Signed and complex measures. Absolute continuity, Lebesgue decomposition. Measure theory, Lebesgue integration, introductory functional analysis.

MATH 7230 FUNCTIONS OF A COMPLEX VARIABLE I (3) LEC. 3. Departmental approval. Complex numbers, analytic functions, derivatives, Cauchy integral theorem and formulae, Taylor and Laurent series, analytic continuation, residues, maximum principles, Riemann surfaces.

MATH 7240 FUNCTIONS OF A COMPLEX VARIABLE II (3) LEC. 3. Pr. MATH 7230. Conformal mappings, families of analytic functions and harmonic analysis.

MATH 7280 ADVANCED THEORY OF ORDINARY DIFFERENTIAL EQUATIONS I (3) LEC. 3. Departmental approval. Existence and continuation theorems for ordinary differential equations, continuity and differentiability with respect to initial conditions, linear systems, differential inequalities, Sturm theory.

MATH 7290 ADVANCED THEORY OF ORDINARY DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7280. Stability theory, periodic solutions, boundary value problems, disconjugacy of linear equations, Green's functions, upper and lower solutions, a priori bounds methods, current research.

MATH 7310 ALGEBRA I (3) LEC. 3. Departmental approval. Groups, Lagrange's Theorem, normal subgroups, factor groups, Isomorphism and Correspondence Theorems. Symmetric groups, alternating groups, free groups, torsion groups. Introduction to rings, correspondence theorems.

MATH 7320 ALGEBRA II (3) LEC. 3. Pr. MATH 7310. Rings, modules, vector spaces, and semi-simple modules. Commutative rings; prime and primary ideals, PIDs are UFD, factorizations in integral domains, field extensions, the Galois Correspondence Theorem.

MATH 7340 RING THEORY (3) LEC. 3. Pr. MATH 7320. Topics on: commutative rings (Cohen-Seidenberg theorems, Krull Intersection Theorem, Dedekind domains), or noncommutative rings (projective modules over Artinian algebras, representation type, Noether-Skolem Theorem, division algebras).

MATH 7360 LIE ALGEBRA (3) LEC. 3. General introduction of Lie algebras including their structures and classifications of semisimple Lie algebras.

MATH 7370 MATRICES I (3) LEC. 3. Departmental approval. Jordan form, functions of a matrix, spectral theorem, singular values, norms, quadratic forms, field of values, inertia; topics of current interest.

MATH 7380 MATRICES II (3) LEC. 3. Pr. MATH 7370. Matrix stability and inertia, inequalities for matrix eigenvalues and singular values, The Kronecker and Hadamard matrix products, the exponential and logarithm matrix map; topics of current interest.

MATH 7390 MULTILINEAR ALGEBRA (3) LEC. 3. Pr. MATH 5370 or MATH 6370. Multilinear algebra, symmetry class of tensors, induced operators, generalized matrix functions, and current research topics.

MATH 7400 FUNCTIONAL ANALYSIS I (3) LEC. 3. Pr. MATH 7210. Departmental approval. Bounded linear transformations and functionals on Banach and Hilbert spaces, weak topologies, linear operators, adjoints, compact operators. Banach algebras, spectral theory, Gelfand transform.

MATH 7410 FUNCTIONAL ANALYSIS II (3) LEC. 3. Pr. MATH 7400. C*-algebras, Hermitian, self adjoint elements, functional calculus for commutative algebras. Normal operators on Hilbert space, spectral theorem, applications, symmetric and self-adjoint operators, normal operators, the spectral theorem.

MATH 7440 PARTIAL DIFFERENTIAL EQUATIONS I (3) LEC. 3. Departmental approval. Second order linear elliptic and hyperbolic equations stressing non-linear and numerical problems, characteristic domains of dependence, energy integrals, finite difference schemes, Sobolev spaces, maximum principle.

MATH 7450 PARTIAL DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7440. Parabolic and hyperbolic equations, stressing numerical problems, characteristics, domains of dependence, energy integrals, reaction-diffusion problems, Navier-Stokes equations, fixed-point and Galerkin methods.

MATH 7460 ADVANCED PERTURBATION METHODS (3) LEC. 3. Departmental approval. Solutions of nonlinear problems and integrals using WKB, Rayleigh-Janzen, Generalized Scales, Latta, van der Pol, Watson, Laplace, Adomian, homotopy, Pade, Liouville-Green and Burmann transformations. May count either AERO 7460/7466 or MATH 7460/7466.

MATH 7500 TOPOLOGY I (3) LEC. 3. Departmental approval. Separation and countability axioms, covering properties, completeness, connectedness, metric spaces and metrizability, product and quotient spaces, function spaces.

MATH 7510 TOPOLOGY II (3) LEC. 3. Pr. MATH 7500. Homotopy, elementary properties of retracts, fundamental groups, covering spaces, computations of fundamental groups.

MATH 7530 CONTINUUM THEORY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Topics such as inverse limits, decompositions, hyperspaces, special mappings, topological structures from the pathological (indecomposable continua), to the straightforward (Peano continua).

MATH 7540 CONTINUUM THEORY II (3) LEC. 3. Pr. MATH 7530. Topics in continuum theory such as confluent mappings, epsilon mappings, chains, to-the-boundary theorems, relationship to inverse limits, advanced topics.

MATH 7550 SET THEORETIC TOPOLOGY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Compactifications, covering properties, metrization theorems and generalized metrizable spaces, topological groups.

MATH 7560 SET THEORETIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7550. Topological Groups, Cardinal invariants, use of set-theoretic axioms such as Martin's Axiom, independence results, advanced topics.

MATH 7600 ADVANCED NUMERICAL MATRIX ANALYSIS (3) LEC. 3. Departmental approval. Topics selected from: discretization matrices, sparse matrices, QR-algorithm, symmetric eigenvalue problems, singular value decomposition, pseudo-inverses, simplex method, matrix algorithms for vector computers.

MATH 7610 NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS I (3) LEC. 3. Pr. MATH 2650 and MATH 2660 and MATH 5630 or MATH 6630 and MATH 5640 or MATH 6640. Finite difference methods for ordinary and partial differential equations.

MATH 7630 NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS II (3) LEC. 3. Pr. MATH 7610. Finite element methods for partial differential equations.

MATH 7700 GRAPH THEORY (3) LEC. 3. Algorithmic, enumerative and theoretical aspects of graph theory: matchings and factors, colorings, Hamiltonicity, connectivity, trees, extremal graphs, planarity. May count either MATH 6750 or MATH 7700.

MATH 7710 COMPUTATIONAL GEOMETRY (3) LEC. 3. Departmental approval. Design and time-complexity of computer algorithms for geometry problems studying the geometric ideas needed for computer-aided design, computer graphics and robotics.

MATH 7720 INTRODUCTION TO CODING THEORY (3) LEC. 3. Introduction to methods and algorithms for reliable communications through error control coding. BCH, Reed- Solomon, Reed-muller codes, convolutional codes, Berlekamp-Massey, Viterbi, and iterated decoding algorithms.

MATH 7730 ADVANCED TOPICS IN CODING THEORY (3) LEC. 3. Pr. MATH 7720. Departmental approval. Structure and theoretical properties of codes and related algorithms. Relations to other combinatorial and algebraic objects stressed.

MATH 7740 ADVANCED COMBINATORIAL DESIGNS (3) LEC. 3. Topics of current interest and research in combinatorial design theory. Areas included: latin squares, embeddings, Wilson's constructions, quadruple systems, Hadamard designs, graph designs, orthogonal arrays.

MATH 7750 ADVANCED TOPICS IN GRAPH THEORY (3) LEC. 3. Pr. MATH 6750 or MATH 7700. Topics of current interest and recent research in graph theory. May include edge colorings, algebraic graph theory, network flows, factor theory.

MATH 7760 INTRODUCTION TO ALGEBRAIC TOPOLOGY I (3) LEC. 3. Pr. MATH 7510. Departmental approval. Homology of chain complexes, the axioms of homology and their verification, computations of homology groups.

MATH 7770 INTRODUCTION TO ALGEBRAIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7760. Homology with coefficients and universal coefficient theorem theorems, Cohomology and universal coefficient theorems, homology of products of spaces, cup and cap products, duality in manifolds.

MATH 7780 ADVANCED ALGEBRAIC TOPOLOGY I (3) LEC. 3. Departmental approval. Advanced topics in homology, cohomology, and duality with relations to and further study of homotopy theory. Applications to and further study of manifolds and geometric topology.

MATH 7790 ADVANCED ALGEBRAIC TOPOLOGY II (3) LEC. 3. Pr. MATH 7780. Continuation of MATH 7780; advanced topics in homology, cohomology, and duality with relations to and further study of homotopy theory. Applications to and further study of manifolds and geometric topology.

MATH 7800 PROBABILITY I (3) LEC. 3. Pr., a full year of undergraduate mathematical analysis at a level commensurate with MATH 5200/5210. Measure-theoretic foundations, independence, conditioning, martingales, Markov property, stationarity, random walks, Markov chains, Poisson processes.

MATH 7810 PROBABILITY II (3) LEC. 3. Pr. MATH 7800. Classical and modern topics in stochastic processes (Markov chains, Poisson process, Brownian motion). Applications and stochastic models (queues, stationary processes, population dynamics, finances). Credit will not be given for both MATH 7810 and STAT 7810.

MATH 7820 APPLIED STOCHASTIC PROCESSES I (3) LEC. 3. Classical and modern topics in stochastic processes (Markov processes, Random Walks, Martingales, Brownian motion). Introduction to stochastic integrals and differential equations. Applications (queues, population dynamics, chaos, finances). Credit will not be given for both MATH 7820 and STAT 7820.

MATH 7830 APPLIED STOCHASTIC PROCESSES II (3) LEC. 3. Classical and modern topics in stochastic processes (Markov processes, Random Walks, Martingales, Brownian motion). Introduction to stochastic integrals and differential equations. Applications (queues, population dynamics, chaos finances).

MATH 7870 REAL FUNCTIONS AND DESCRIPTIVE SET THEORY I (3) LEC. 3. Pr. MATH 7210 or MATH 7500. Borel classification of sets, the Baire classification of real functions. Derivatives and approximately continuous functions. The Lebesegue density topology.

MATH 7880 REAL FUNCTIONS AND DESCRIPTIVE SET THEORY II (3) LEC. 3. Pr. MATH 7870. Analytic and coanalytic sets. Lebesegue measurable, universally measurable and Marczewski measurable sets and functions. Baire properties. Singular sets. Category analogs to real analysis.

MATH 7950 SEMINAR (1-3) SEM. SU. Course may be repeated for a maximum of 6 credit hours.

MATH 7960 SPECIAL PROBLEMS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 10 credit hours.

MATH 7970 SPECIAL TOPICS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated with change in topics.

MATH 7980 RESEARCH AND SPECIAL PROJECT IN APPLIED MATHEMATICS (1-10) RES. SU. Departmental approval. For students working on the Master of Applied Mathematics degree with concentration in numerical analysis. Course may be repeated for a maximum of 10 credit hours.

MATH 7990 RESEARCH AND THESIS (1-10) MST. Course may be repeated with change in topics.

MATH 8310 HOMOLOGICAL ALGEBRA I (3) LEC. 3. Pr. MATH 7320. Departmental approval. Homology and cohomology. Hom and Tensor functors; the adjoint isomorphisms, injective/projective modules, flat modules, the classification of certain rings using homological tools.

MATH 8330 INTRODUCTION TO LIE GROUPS (3) LEC. 3. Pr. MATH 7310 or MATH 7370. Introduce Lie groups via matrix groups. Topics include exponential map, Lie algebras, classical groups, structures and classifications, manifolds, representations.

MATH 8960 SPECIAL PROBLEMS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 15 credit hours.

MATH 8970 SPECIAL TOPICS (1-10) IND. Departmental approval. Topics may vary as needed. Course may be repeated for a maximum of 15 credit hours.

MATH 8990 RESEARCH AND DISSERTATION (1-10) DSR. Course may be repeated with change in topics.