Mathematics (MATH)

MATH 0900. Transitional Math I. 4 Hours.
Designed for students with an ACT Math score of 0-17 or equivalent placement score. For students needing to learn or review basic mathematics skills. Covers operations on whole numbers, fractions, decimals, percent with applications, ratios and proportions, signed numbers, linear equations with applications, positive integral exponents, geometry, and polynomials. Graphing and polynomial factoring will be introduced. Successful completers (Grade C or higher) will be prepared to enroll in MATH 1010. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Perform arithmetical operations on whole numbers, fractions, decimals, and signed numbers without a calculator. 2. Perform mathematical processes with percentages and use them in real-life applications. 3. Use variables to represent unknown numbers. 4. Identify geometric figures and formulas and applying knowledge to angles, perimeters, areas, and volumes. 5. Use the mathematical processes of whole numbers, fractions, decimals, percentage, signed numbers, proportion/rations, and algebraic equations with problems solving skills in real-life modeling exercises. 6. Graph linear equations in two variables by plotting points. Course fee required. FA, SP, SU.

MATH 0980. Transitional Math IIB. 4 Hours.
Prepares students for courses that fulfill the General Education Math requirement for non-science and technology degrees, i.e., Math 1030 - Quantitative Reasoning and Math 1040 - Introduction to Statistics specifically. Concepts emphasized in this course include the algebra, geometry, and statistics needed to move directly into Quantitative Reasoning and Introduction to Statistics. Students will be expected to reason mathematically, apply mathematical concepts to real-world experiences, and build the foundational skills necessary for success in their next course. Students who successfully complete Math 0980 will satisfy the prerequisite for Math 1030 & Math 1040. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop problem-solving skills in real-world modeling exercises utilizing whole numbers, fractions, decimals, percentages, signed numbers, proportions/ratios, and algebraic equations. 2. Use algebraic processes to solve algebraic equations with one unknown. 3. Graph linear equations in two variables using various techniques. 4. Analyze and apply linear equations in two variables and their graphs to real-world problems. 5. Calculate and interpret measures of central tendency from data. 6. Compute basic probabilities theoretically and from empirical data. Course fee required. Prerequisites: Math 0900 (Grade C or higher) or ACT placement score of 12 or higher, or equivalent test score within two years of enrollment in this course. FA, SP, SU.

MATH 1010. Intermediate Algebra. 4 Hours.
Prepares students for courses that fulfill the General Education Math requirement. Concepts emphasized include the properties of the real number system, sets, functions, graphs, algebraic manipulations, linear and quadratic equations, systems of equations, and story problems. Students will be expected to reason mathematically and solve mathematical problems. Successful completion of the course gives students good preparation for college-level Math courses. Successful completers satisfy prerequisite for MATH 1030, MATH 1040, MATH 1050, MATH 1080, and Mathematics prerequisite for CHEM 1110, IT 3050, PHYS 1010, SOC 3112, and STAT 2040. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Perform basic mathematical operations on rational numbers with and without a calculator, including fractions, percentages, and decimals. 2. Solve algebraic, logarithmic and exponential equations in one and/or two unknowns. 3. Demonstrate the concept of equivalence including the use of variables to define relationships. 4. Use functions to analyze models of real-world problems including polynomial and quadratic equations. Course fee required. Prerequisites: MATH 0900 or MATH 0980 (Grade C or higher), OR ACT math score of 18 or higher or equivalent placement score, within two years of enrollment in this course. FA, SP, SU.

MATH 1020R. Bridge Into College Mathematics. 1 Hour.
Optional bridge course preparing students to take the college placement exam with the goal of testing into MATH 1010, MATH 1030, MATH 1040. Intended for students whose current placement score or prerequisites have expired or whose current placement is near the required score. Each student follows an individualized path of study to reach this goal. Requires mandatory class attendance and a minimum amount of time logged into the preparation module each week. Will be graded as P/F and may be graded credit/no credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Improve problem-solving skills via a personalized study plan tailored to each student's unique strengths and weaknesses. 2. Learn study habits and techniques to succeed in general education mathematics courses. 3. Prepare to take the college placement mathematics exam with the goal of eliminating the need for at least one semester of developmental mathematics. Course fee required. SU.

MATH 1030. Quantitative Reasoning (MA). 3 Hours.
Fulfills General Education Mathematics requirement for students in Fine Arts, Liberal Arts, Elementary Education, and other degrees. Focuses on development of analytical problem solving skills through the application of various mathematical concepts to real-life problems. Topics include logic; financial math; problem solving; numeration systems; geometry; measurements; probability; statistics; and modeling with algebra. A class presentation is required for this course. Students are cautioned to check degree and/or transfer requirements before taking this course. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use algebra to graphically represent and analyze linear, quadratic, exponential, and logarithmic models. 2. Assess methods of geometry used in artistic representations of the world. 3. Identify aspects of logic used to solve complex problems and use logic to make sound decisions in personal and business life. 4. Use trigonometry to solve triangles and related applications. 5. Use principles of finance to calculate simple and compound interest, values of annuities, and amortization schedules. 6. Apply the concepts of probability to calculate outcomes and the corresponding odds in the games that people play. 7. Use statistical techniques to organize, display, and analyze data, especially as it applies to situations in the real world. Course fee required. Prerequisites: MATH 0980 or MATH 1000 or MATH 1010 (Grade C or higher), MATH 0980 recommended, or ACT math score of 20 or higher, or an equivalent placement score within two years of enrollment in this course. FA, SP, SU.

MATH 1040. Introduction to Statistics (MA). 3 Hours.
Fulfills General Education Mathematics requirement for students majoring in Communications, Social & Behavioral Sciences, Fine Arts, Liberal Arts, or Exercise Science. Introduction to basic concepts and methods used in statistical data analysis, includes descriptive statistics, sampling, and inferential methods while emphasizing problem solving and critical thinking. Data comparisons such as t-tests and ANOVA will also be covered. StatCrunch is used to perform statistical calculations, organize and analyze data, and construct graphs. Required for Utah Level 2 Math Endorsement. Students are cautioned to check degree and/or transfer requirements before taking this course. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Distinguish among various types of variables and basic statistical terms. 2. Organize and summarize qualitative and quantitative date using different display methods. 3. Interpret and apply Least-Square linear regression. 4. Implement basic probability rules, counting techniques and various probability distributions. 5. Construct and interpret confidence intervals for various population parameters using sampling distribution and various sample statistics. 6. Perform and analyze goodness- of-fit test and ANOVA test and demonstrate proficiency with test hypotheses about various population parameters with one or two samples. Course fee required. Prerequisites: MATH 0980 or higher (Grade C or higher), or ACT math score of 22 (or equivalent placement score) or higher, within two years of enrollment in this course. FA, SP, SU.

MATH 1050. College Algebra / Pre-Calculus (MA). 4 Hours.
Fulfills General Education Mathematics requirement for students majoring in Business, Elementary Education, Health Sciences, Science, and other majors. Reviews fundamental algebra; explores polynomial and rational functions; introduces exponential and logarithmic functions and applications; conics; systems of linear equations and applications; arithmetic and geometric sequences and series, binomial coefficients and the Binomial Theorem; basic principle of counting. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Graph, analyze, find intercepts, maxima, and minima of polynomial, rational, exponential, and logarithmic functions. 2. Solve non-linear and linear systems equations and inequalities using substitution, elimination, Cramer's rule, and linear programing. 3. Find terms and sums of arithmetic and geometric sequences and series, compute the terms of a binomial expression, solve counting problems. Course fee required. Prerequisite: MATH 1010 or MATH 1000 (Grade C or higher) OR ACT math score of 23 or higher, or equivalent placement score within two years of enrollment in this course. FA, SP, SU.

MATH 1060. Trigonometry (MA). 3 Hours.
Fulfills General Education Mathematics requirement. Continuation of MATH 1050, utilizes unit circle and right triangle definitions, graphs of trigonometric functions, solving trigonometric equations, and verifying trigonometric identities. Involves polar and parametric functions, vectors, and conic sections. Required for Utah Level 2 and Level 3 Math Endorsements. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Manipulate and evaluate trigonometric functions. 2. Use proofs to work with trigonometric functions to prove trigonometric identities. 3. Demonstrate the ability to use trigonometric identities to solve real world applications. 4. Use vectors geometrically and algebraically to solve problems. Course fee required. Prerequisites: MATH 1050 (Grade C or higher) ACT math score of 25 or higher, or equivalent placement score within two years of enrollment in this course. FA, SP, SU.

MATH 1080. Pre-Calculus with Trigonometry (MA). 5 Hours.
Fulfills General Education Mathematics requirement. Provides in-depth review of college algebra and trigonometry before entering trig-based calculus by reviewing concepts taught in MATH 1050 and MATH 1060. Successful completion fulfills prerequisite for MATH 1210, and Mathematics prerequisite for PHYS 2010. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze the key components of the graphs of polynomial and rational functions. 2. Solve real-world applications by applying trigonometric functions. 3. Derive new trigonometric identities through proper application of established identities. 4. Apply the algebraic and geometric techniques of vectors to solve problems. Course fee required. Prerequisites: MATH 1010 or MATH 1000 (Grade B or higher), or ACT math score of 25 or higher, or equivalent placement score within two years of enrollment in this course. FA, SP.

MATH 1100. Business Calculus (MA). 3 Hours.
Fulfills General Education Mathematics requirement. Required of majors in the Udvar-Hazy School of Business, as well as students majoring in Computer & Information Technology. Emphasizes functions, modeling, differentiation, applications of differentiation, exponential and logarithmic functions, integration, applications of integration, and functions of several variables. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss and analyze the concepts of limits and the interrelationships of the graphic, numeric, and symbolic approaches to limits. 2. Discuss and analyze functions by computing and interpreting their first and second derivatives. 3. Apply basic calculus techniques to data and functions that serve to model real-life applications in career areas such as business, economics, social science, and architecture. 4. Apply the definite integral as the limit of a sum to applications in business, economics, sociology, ecology, and other areas. Course fee required. Prerequisites: MATH 1050 (Grade C or higher), ACT math score of 25 or higher, or equivalent placement score within two years of enrollment in this course. FA, SP, SU.

MATH 1210. Calculus I (MA). 4 Hours.
Fulfills General Education Mathematics requirement. Students will gain a basic understanding of calculus, including limits and derivatives, differentiation rules, applications of differentiation and integrals. Students must have a working knowledge of college algebra and trigonometry. Required for Utah Level 2, 3, and 4 Math Endorsements, and for students majoring in Computer Science, Computer and Information Technology-- Software Development Emphasis, Biology, Physical Science Composite Teaching and Pre-engineering. Successful completion fulfills prerequisite for MATH 1220, and Mathematics prerequisite for ENGR 2010 and PHYS 2210. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Evaluate limits algebraically, numerically, graphically, and through L'Hospital's Rule. 2. Apply the definition of a derivative and derivative rules to differentiate functions, and then apply the derivative in solving real world problems. 3. Perform integration by various techniques. 4. Compute the area under a curve through approximation techniques, and through proper use of the definite integral. Course fee required. Prerequisite: MATH 1060 (Grade C or higher); OR MATH 1080 (Grade C or higher); OR ACT math score of 26 or higher or equivalent placement score within two years of enrollment of this course. FA, SP.

MATH 1220. Calculus II (MA). 4 Hours.
Fulfills General Education Mathematics requirement. Continuation of MATH 1210, covering applications of integration, differential equations, infinite sequences and series. Required for Utah Level 3 and 4 Math Endorsements, and for students majoring in Mathematics, Chemistry, Computer Science and Physical Science Composite Teaching. Successful completion fulfills prerequisite for MATH 2210, and Mathematics prerequisite for ENGR 2250, ENGR 2300, and PHYS 2220. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a basic understanding of advanced integration techniques, including approximate integration. 2. Use integrals to formulate and solve application problems in science, engineering, biology, and economics. 3. Using the techniques of differential equations to predict population growth and decay. 4. Demonstrate knowledge of sequences and series including tests for convergence and methods of approximation of sums. 5. Explore methods of determining convergence and evaluation limits of sequences and series. Course fee required. Prerequisite: MATH 1210 (Grade C or higher). FA, SP.

MATH 2010. Math for Elementary Teachers I. 3 Hours.
The first course in a 2-semester sequence of mathematics appropriate to the needs of elementary and middle school teachers. Includes problem solving, sets, numeration systems, whole numbers, algorithms of arithmetic, number theory, rational numbers and decimal numbers. Required for Utah Elementary Education (Level 1) and Level 2 Math Endorsements. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate competent problem solving skills. 2. Demonstrate knowledge of spatial and visual mathematical thinking. 3. Effectively communicate orally and in written form mathematical concepts and mathematical reasoning. 4. Demonstrate a knowledge of mathematics thinking required to fully understand k-6 curriculum. 5. Demonstrate a knowledge of, and ability to, connect elem. mathematics concepts to physical objects. Course fee required. Prerequisites: MATH 1030 (Grade C or higher) or MATH 1050 (Grade C or higher), MATH 1030 preferred. FA, SP.

MATH 2020. Math for Elemen Teachers II. 3 Hours.
The second course in a 2-semester sequence of mathematics appropriate to the needs of elementary and middle school teachers. Continuation of Math 2010. Includes real numbers, statistics, probability, geometry, measurement, and algebra. Required for Utah Elementary Education (Level 1) and Level 2 Math Endorsements. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate various viewpoints of mathematical thinking. 2. Demonstrate competent problem solving skills. 3. Show examples of spatial and visual mathematical thinking. 4. Effectively communicate orally and in written form mathematical concepts and mathematical reasoning. 5. Demonstrate a knowledge of mathematics thinking required to fully understand k-6 curriculum. Prerequisite: MATH 2010 (Grade C or higher). FA, SP.

MATH 2050. Applied Statistics with Programming. 3 Hours.
This course provides an introduction to statistical programming from describing raw data (descriptive statistics) to making statistical conclusions (inferential statistics) based on real data from practical problems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Interpret, summarize and graph practical data set using statistical programming. 2. Conduct appropriate statistical analysis of practical data set using statistical programming. 3. Interpret and understand the results of statistical analyses from statistical program. 4. Develop conclusions and decisions based on the statistical analysis results. Prerequisites: MATH 1040 (Grade C or higher) or a higher MATH course (Grade C or higher) or STAT 2040 (Grade C or higher). FA.

MATH 2200. Discrete Mathematics. 3 Hours.
Introduction to proofs and writing Mathematics. Covers Logic (including Boolean), Sets, Functions, Equivalence Relations, Modular Arithmetic, and Graph Theory. Also covers prepositional calculus, combinatorics, and Counting Methods. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop and write basic logical arguments including proofs by induction, construction, and contradiction. 2. Read logical arguments critically. 3. Recognize the principles of logic and set theory as those forming the foundations of such fields as computer science, mathematics, and philosophy. 4. Apply the principles of logic and set theory to solve foundational problems in these fields. 5. Enumerate discrete structures of a given kind and size via the use of combinations, permutations, and other combinatorial constructs. 6. Utilize the TeX/LaTeX typesetting environment to produce technical and mathematical papers that meet the current formatting standard for circulation and dissemination within the scientific community. Course fee required. Prerequisite: MATH 1210 (Grade C or higher). SP.

MATH 2210. Multivariable Calculus (MA). 4 Hours.
Fulfills General Education Mathematics requirement. Continuation of MATH 1220. Includes vectors and the geometry of space, vector functions, partial derivatives, multiple integrals, and vector calculus. Required for Utah Level 3 and Level 4 Endorsement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use plane and space vectors to solve applications in geometry and physics. 2. Use space curves to analyze the motion of an object. 3. Use contour diagrams to analyze the behavior of a function of several variables. 4. Use partial derivatives to solve optimization problems. 5. Set up and compute double and triple integrals in order of integration using rectangular coordinates. 6. Set up and compute double and triple integrals using polar, cylindrical, and spherical coordinates. 7. Use line integrals to compute the work done by a vector field along a curve. 8. Use surface integrals to compute the flux of a vector field through a surface. 9. Use multiple integrals to calculate some line and surface integrals. Course fee required. Prerequisite: MATH 1220 (Grade C or higher). FA, SP.

MATH 2250. Differential Equations and Linear Algebra. 4 Hours.
Linear systems, abstract vector spaces, matrices through eigenvalues and eigenvectors, solution of ode's Laplace transform, first order systems. For Engineer majors. Covers the following methods of solving ordinary differential equations (along with applications of such): separation of variables, homogenous and non-homogeneous, exact, first-order and higher, integrating factors, substitution methods, linear and non-linear, complex characteristics, variation of parameters, undetermined coefficients (superposition and annihilator approach), and Euler-Cauchy. Will introduce power series solutions, and the Laplace transform. Covers matrix and vector analysis, linear dependence and independence, matrix algebra, diagonalization, eigenvalues and eigenvectors, linear transformations (kernel and range), and vector spaces and subspaces (including null, column, and bases). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Solve ordinary differential equations via the use of the following solution types: exact, implicit, series, and discrete application. 2. Solve systems of linear ordinary differential equations via the use of differential operators, Laplace transformations, and matrix methods. 3. Utilize ordinary differential equations as well as systems thereof to obtain solutions to related application problems. Course fee required. Prerequisites: Math 1220 (Grade C or higher). SP.

MATH 2270. Linear Algebra. 3 Hours.
For Mathematics and pre-Engineering majors. Covers matrix and vector analysis and systems of equations with applications, linear dependence and independence, matrix algebra and invertibility, determinants and their applications, Cramer's Rule, diagonalization, eigenvalues and eigenvectors, linear transformations (kernel and range), inner product, orthogonality, vector spaces and subspaces, including null and column and bases as well as introducing basic proof theory. Required for Utah Level 3 and 4 Math Endorsements. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn basic vocabulary, symbol, definition used in linear algebra. 2. Solve systems of Linear equations using multiple methods. 3. Demonstrate basic understanding of the concept of linear transformation, vector space and subspace, linear independence, span, basis, dimension and rank. 4. Perform matrix algebra, calculating determinants, finding eigenvalues, eigenvectors and solve eigenvalue problems. 5. Apply the concepts of linear models to various applications. Course fee required. Prerequisite: MATH 1210 (Grade C or higher). FA, SP.

MATH 2280. Ordinary Differential Equations. 3 Hours.
For Mathematics and pre-Engineering majors. Covers methods of solving ordinary differential equations with applications: separation of variables, homogeneous and non-homogeneous, exact, first and higher order, integrating factors, substitution methods, linear and non-linear, complex characteristic roots, variation of parameters, undetermined coefficients (superposition and annihilator approach), and Euler-Cauchy. Systems of equations, power series solutions, and the Laplace transform will be introduced. Required for Utah Level 4 Math Endorsement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Solve ordinary differential equations via the use of the following solution types: exact, implicit, series, and discrete application. 2. Solve systems of linear ordinary differential equations via the use of differential operators, Laplace transformations, and matrix methods. 3. Utilize ordinary differential equations as well as systems thereof to obtain solutions to related application problems. Course fee required. Prerequisite: MATH 1220 (Grade C or higher). SP.

MATH 2285. Adventures in Modeling. 1 Hour.
In this course, students will meet once a week to learn a variety of mathematical techniques and their applications to real world problems. The weekly class meetings will begin with a brief introduction to a mathematical concept, with the remainder of the class devoted to working in a team on a given problem. Practice problems will be drawn from those offered in the COMAP Mathematical or Interdisciplinary Contest for Modeling (MCM/ICM). Students will also have the opportunity to compete in teams of their choice in the annual MCM/ICM contest offered mid-February or AMATYC Student Research League offered end of April. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Construct mathematical models based on real-world problems. 2. Identify mathematical techniques appropriate for their models or analysis. 3. Solve interdisciplinary problems working in teams, and write a scientific report describing the mathematical model and results. 4. Demonstrate logical reasoning, and quantitative skills by participating in modeling competitions. Prerequisites: MATH 1210 (Grade C or higher). FA.

MATH 2905. Survey of Cryptography. 3 Hours.
This course is based on the Basic Cryptography Knowledge Unit as defined by the National Security Administration for institutions of higher education. The intent of this course is to provide students with a basic understanding of cryptography and where and how it is used. This course will involve basic programming. A project is required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Students will be able to identify the elements of a cryptographic system. 2. Students will be able to describe the differences between symmetric and asymmetric algorithms. 3. Students will be able to determine which cryptographic protocols, tools and techniques are appropriate for a given situation. 4. Students will be able to outline how crypto can be used, strengths and weaknesses, modes, and issues that have to be addressed in an implementation. Prerequisites: MATH 1210 and CS 1400 (Both grade C or higher). SP (even).

MATH 3000. History of Mathematics. 3 Hours.
This course provides an exploration into the historical development of mathematics. The curriculum aims to trace the evolution of important mathematical concepts from their historical inception to their modern form, interpreted through the lens of various cultures and societies. An integral part of this study is the examination of the roles of power and privilege within the history of mathematics education. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn the development of mathematical topics, such as geometry, algebra, and calculus within their historical context focusing on the applications that have driven key discoveries. 2. Investigate the roles and roots of power and privilege in math history and learn to identify potential inequities and promote equitable opportunities. 3. Recognize the value of diversity in culture, language, and thought in the historical development of approaches to mathematics. 4. Learn how to solve mathematics problems in the style of each culture under study. Prerequisite: MATH 1220 (Grade C or higher). FA (odd).

MATH 3010. Algebra for Secondary Mathematics Teaching. 3 Hours.
A content course designed for Math Education majors who aspire to teach mathematics at the secondary school level. This course is designed to provide a deeper understanding of the content knowledge needed for teaching algebraic content in middle school and high school mathematics classes and strategies for delivering that content in an equitable, learner-centered environment. Using the historical development of content and perspectives from diverse cultures, this course explores the roles and roots of power and privilege in the history of mathematics education. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a rigorous and comprehensive understanding of the algebraic content in the Utah mathematics core curriculum. 2. Learn strategies for delivering algebraic content, focusing on providing equitable access, support, and challenges in a learner-centered environment. 3. Analyze diverse mathematical approaches to algebraic topics with an eye toward leveraging student funds of knowledge to enhance student progression in mathematical learning. 4. Demonstrate practices and processes for teaching students to make connections to mathematical applications within the context of algebra. 5. Demonstrate proficiency with tools and technology designed to support mathematical reasoning and sense-making within the context of algebra. Prerequisite: MATH 1210 (Grade C or higher). FA (even).

MATH 3020. Geometry and Statistics for Secondary Mathematics Teaching. 3 Hours.
A content course designed for Math Education majors who aspire to teach mathematics at the secondary school level. This course is designed to provide a deeper understanding of the content knowledge needed for teaching geometric and statistical content in middle school and high school mathematics classes and strategies for delivering that content in an equitable, learner-centered environment. Using the historical development of content and perspectives from diverse cultures, this course explores the roles and roots of power and privilege in the history of mathematics education. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a rigorous and comprehensive understanding of the geometric and statistical content in the Utah mathematics core curriculum. 2. Learn strategies for delivering geometric and statistical content, focusing on providing equitable access, support, and challenges in a learner-centered environment. 3. Analyze diverse mathematical approaches to geometric and statistical topics with an eye toward leveraging student funds of knowledge to enhance student progression in mathematical learning. 4. Demonstrate practices and processes for teaching students to make connections to mathematical applications within the contexts of geometry and statistics. 5. Demonstrate proficiency with tools and technology designed to support mathematical reasoning and sense-making within the contexts of geometry and statistics. Prerequisite: Math 1210 (Grade C or higher). FA (odd).

MATH 3050. Stochastic Modeling and Applications. 3 Hours.
The purpose of this course is to equip students with basic theoretical and practical knowledge of stochastic modeling, which is very important and necessary for the analysis of stochastic dynamical systems in many application including economics, engineering, and other other fields. Emphasis will be placed on understanding the stochastic processes, how to model problems, and how to use technology to solve real-world problems. Throughout this course, different real-world problems will be discussed and solved using computational tools. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the basic concepts of stochastic processes. 2. List the different important stochastic processes, their properties and characteristics. 3. Model and solve real-life problems using stochastic processes. Prerequisites: MATH 2050 OR STAT 2040 OR MATH 3060 OR Math 3400 (Grade C or higher). SP.

MATH 3060. Statistics for Scientists. 3 Hours.
The purpose of this course will be to provide undergraduate students a solid background in the core concepts of applied biological statistics and the use of the software R for data analysis. Specific topics include tools for describing central tendency and variability in data; methods for performing inference on population means and proportions via sample data; statistical hypothesis testing and its application to group comparisons; issues of power and sample size in study designs; and random sample and other study types. While there are some formulae and computational elements to the course, the emphasis is on interpretation and concepts. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Recognize the importance of data collection and its role in determining scope of inference. 2. Demonstrate a solid understanding of interval estimation and hypothesis testing. 3. Choose and apply appropriate statistical methods for analyzing one or two variables. 4. Interpret statistical results correctly, effectively, and in context. 5. Use R to perform descriptive and inferential data analysis for one or two variables. FA, SP.

MATH 3100. Euclidean / Non-Euclidean Geom. 3 Hours.
Includes axiomatic development of Euclidean and non-Euclidean geometry. Computer-based GeoGebra program is used. Required for Utah Level 3 and 4 Math Endorsements. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the role of axioms in Euclidean and Non-Euclidean geometry. 2. Proficiently write geometric rigorous proofs. 3. Use technology to explore and conjecture geometric results. Prerequisite: MATH 2200 (Grade C or higher). SP (odd).

MATH 3120. Transition to Advanced Mathematics. 3 Hours.
An introduction to proofs and the mathematical writing needed for advanced mathematics courses. This course covers logic and methods of mathematical proof in the framework of sets, relations, functions, cardinality, etc. A project is required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Reformulate statements from common language to formal logic and develop proofs of these statements using common proof methods. 2. Apply the creative process of inventing and discovering new mathematical theories. 3. Apply the methods of thought that mathematicians use in verifying theorems, exploring mathematical truth and developing new mathematical theories for application. 4. Utilize the LaTeX typesetting environment to produce technical and mathematical papers that meet the current formatting standard for circulation within the scientific community. Prerequisites: MATH 2200 or CS 2100 (Grade C or higher); and MATH 1220 (Grade C or higher). FA.

MATH 3150. Introduction to Partial Differential Equations. 3 Hours.
First-Order Partial Differential Equations (PDEs), Second-Order PDEs, Fourier Series, The Heat Equation, The Wave Equation, Laplace's Equation, The Fourier Transform Methods for PDEs. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the wave, heat, and Laplace equations and their applications. 2. Utilize Fourier series and the Fourier transform to solve partial differential equations. 3. Understand Sturm-Liouville eigenvalue problems and receive an introduction to solving PDEs numerically. Prerequisite: MATH 2210 and MATH 2270 and MATH 2280 (all Grade C or higher). FA (odd).

MATH 3200. Introduction to Analysis I. 3 Hours.
This course provides an introduction to the fundamental concepts of mathematical analysis, covering sets and real numbers, sequences and series, basic topology, limits and continuity, the derivative, and sequences and series of functions. The course emphasizes the development of critical thinking and logical reasoning skills, as well as the ability to communicate mathematical ideas effectively through constructing clear, logical proofs. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a foundational understanding of the key concepts and principles of mathematical analysis for functions of one variable. 2. Appreciate the axiomatic approach to mathematics and application of fundamental principles to build robust mathematical models. 3. Communicate mathematical ideas effectively in writing and speech, emphasizing clear, logical proofs. 4. Apply the techniques of mathematical analysis to solve problems in other areas of mathematics. Prerequisites: MATH 3120 (Grade C or higher); AND MATH 1220 (Grade C or higher). SP.

MATH 3210. Introduction to Analysis II. 3 Hours.
This course is a continuation of the study of mathematical analysis begun in Introduction to Analysis I. It covers advanced topics in analysis, including metric spaces, point-set topology, and differentiation and integration in higher dimensions. The course aims to further develop students' ability to think critically and logically, and to communicate mathematical ideas effectively. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate a foundational understanding of the key concepts and principles of mathematical analysis for functions of multiple variables. 2. Develop critical thinking and logical reasoning skills necessary for solving mathematical problems in the context of advanced multivariable calculus. 3. Construct and analyze rigorous mathematical arguments that demonstrate a thorough command of accepted notation and terminology and a strong understanding of introductory real analysis. Prerequisite: MATH 3200 (Grade C or Higher); AND MATH 2210 (Grade C or higher). FA (even).

MATH 3400. Probability & Statistics. 3 Hours.
Mathematics- based statistics. Topics include: Concepts in probability, discrete, continuous and bivariate distributions, distributions of functions of random variables, point and interval estimation, tests of hypothesis, and regression. Calculators with statistical functions is required. Required for Utah Level 3 and 4 Math Endorsement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe properties of probability, counting Techniques, conditional probability and Bayes' Theorem. 2. Use Discrete random variables and Discrete distributions like Binomial, Negative binomial and Poisson distributions. 3. Apply continuous random variables and Continuous distributions like Normal, Exponential, Gamma and Chi-square distributions. 4. Organize Bivariate distributions of discrete and continuous type. 5. Interpret Distributions of functions of one, two or several random variables, Moment-Generating functions and central limit theorem. Prerequisites: MATH 1210 (Grade C or higher). FA.

MATH 3410. Actuarial Exam P/1 Preparation. 1 Hour.
Recommend students to take this class at the same semester as Math 3400. Prepare for Exam P/1 by working on sample exam questions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate through testing the ability to take the Actuarial Probability exam (SOA Exam P/CAS Exam1). Prerequisites: MATH 3400 (Grade C or higher, can be concurrently enrolled). FA.

MATH 3450. Statistical Inference. 3 Hours.

Topics include: point estimation, maximum likelihood estimators and their distributions, sufficient statistics, and Bayesian estimation, confidence intervals for means and proportions, distribution-free confidence intervals for percentiles, confidence intervals for regression coefficients, and re-sampling methods, test hypothesis for means and proportions, The Wilcoxon tests, the power of a test, best critical regions and likelihood ratio tests,, standard chi-square tests, analysis of variance including general factorial designs, and some procedures associated with regression, correlation and statistical quality control. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the concepts of point estimations, order statistics, maximum likelihood estimation, regression, sufficient statistics, and Bayesian Estimation. 2. Construct and interpret confidence intervals for means, differences of two means, proportions, and Percentiles. 3. Explain the concepts of statistical hypotheses, power of statistical test and best critical regions. 4. Perform and interpret hypothesis test for means, proportions. 5. Perform and interpret Chi-square Goodness-of-Fit tests, Test for homogeneity, Test for independence of attributes of classification, One-Factor Analysis of Variance and Two-Way Analysis of Variance. Prerequisites: MATH 3400 (Grade C or higher). SP.

MATH 3500. Numerical Analysis. 3 Hours.

Includes numerical solutions of nonlinear equations, interpolation and approximation, numerical integration and differentiation, and solutions of linear systems, numerical solutions of ordinary and partial differential equations, using Maple software to implement various algorithms numerically. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify issues of round-off error in numerical approximation using computers/technology. 2. Discuss stability of algorithms, rate of convergence, absolute error and relative error. 3. Implement different root finding algorithms. 4. Construct and use Lagrange polynomials for interpolation and approximation of continuous functions. 5. Implement other types of interpolation methods and perform numerical differentiation and integration methods. 6. Numerically solve ordinary differential equations with initial values. Prerequisites: MATH 2270 AND MATH 2280 (Both grade C or higher), OR MATH 2250 (Grade C or higher). FA (even).

MATH 3605. Introduction to Modeling and Simulation. 3 Hours.

This course introduces students to the fundamentals of mathematical modeling and simulation through the formulation, analysis, and testing of mathematical models in a variety of areas. Emphasis is on the use of elementary functions to investigate and analyze applied problems and questions, supported using appropriate technology, and on effective communication of quantitative concepts and results. Throughout the course, computational tools are used to implement, examine, and validate these models. Offered upon sufficient student demand. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Transform real-world problems into mathematical form (model). 2. Compute solutions, either exact or approximate, to mathematical models. 3. Translate model solutions back to the real-world context. 4. Assess the quality and reliability of mathematical models. 5. Develop logical reasoning, and quantitative skills. 6. Interpret and communicate their analyses in written and oral form. Prerequisites: MATH 1210 (Grade C or higher). FA (odd).

MATH 3700. Mathematical Modeling I. 4 Hours.

Development of mathematical models arising in various areas of applications including the mathematical sciences, operations research, engineering and the management and life sciences, and their solution using a wide variety of tools. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Assess and articulate what type of modeling techniques are appropriate for a given dynamical system. 2. Construct a mathematical model of a given dynamical system and analyze it. 3. Predict the behavior of a given dynamical system based on the analysis of its mathematical model. 4. Develop facility in interpreting mathematical models and the conclusions based on the models. Prerequisites: MATH 2280 (Grade C or higher). FA (even).

MATH 3900. Number Theory. 3 Hours.

Overview of number theory and its applications, including the integers, factorizations, modular arithmetic, congruencies, Fermat's and Euler's Theorems, diophantine equations, cryptography, and RSA algorithm. Required for Utah Level 4 Math Endorsement. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Define and investigate divisibility, modular arithmetic, primitive roots, and number theoretic functions. 2. Apply number theory to coding and/or cryptography. 3. Use technology to solve number theoretic applications. 4. Produce rigorous proofs in the context of number theory. Prerequisite: MATH 1210; and MATH 2200 or CS 2100 (Grade C or higher). SP (even).

MATH 3905. Cryptography and Codes. 3 Hours.

Applied introduction to classical and modern cryptography. Includes a brief review of the required mathematics, including modular arithmetic and matrix algebra (previous knowledge of these topics is not required). Introduces symmetric (private key) and asymmetric (public key) cryptography, focusing on the algorithms, their security, and attacks on them. Also introduces error-correction codes and and current trends and topics in cryptography. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the differences, challenges, and roles of private-key versus public-key cryptography. 2. Employ modular arithmetic and matrix algebra in applications of cryptography and error-correcting codes. 3. Demonstrate understanding of the theory, application, and weaknesses of classical cryptosystems. 4. Simulate classical and modern cryptosystems as well as error-correcting codes. 5. Apply the common methods of attack on cryptosystems to test security. Prerequisites: CS 1400 (Grade C or higher); and MATH 2200 or CS 2100 (Grade C or higher). FA (even).

MATH 4000. Foundations of Algebra. 3 Hours.

For students in all Math-related majors. Covers an introduction to algebraic systems including group rings, fields and sets. Required for Utah Level 3 and 4 Math Endorsements. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the definition and basic properties of groups, rings, and fields. 2. Analyze and prove examples of subgroups, normal subgroups, and quotient groups. 3. Use the concepts of homomorphism and isomorphism for groups, rings, and fields. 4. Produce rigorous proofs in the context of Abstract Algebra. Prerequisites: MATH 2270 (Grade C or higher) and MATH 3120 (Grade C or higher). FA.

MATH 4005. Quantum Computing and Cryptography. 3 Hours.
The intent of this course is to introduce quantum computing to a broad audience of computer scientists, engineers, mathematicians, and anyone with a general interest with a sufficient background in mathematics. A hands-on approach is taken throughout, and students will utilize freely available quantum computer developer tools to form a basic understanding of ideas. Topics discussed are the mathematical models of superposition, measurement, and entanglement and how these ideas coalesce to make quantum computing possible. Known quantum algorithms will be introduced as will their impact on current cryptosystems. Previous exposure to quantum mechanics is not required. **COURSE LEARNING OUTCOMES (CLOs) At the successful completion of this course, students will be able to: 1. Explain the elementary quantum phenomena that render quantum technologies viable. 2. Contrast classical computing with new quantum computing approaches to problem solving. 3. Outline the potential benefits and key areas of application of quantum technologies and the challenges in attaining them. 4. Simulate basic quantum algorithms in the context of cryptography. Prerequisites: CS 1400 and either MATH 2250 or MATH 2270 (Both grade C or higher). SP (odd).

MATH 4010. Abstract Algebra II. 3 Hours.
Continuation of MATH 4000. This course is a continuation of Abstract Algebra I and focuses on a deeper understanding of algebraic structures. We will continue studying group theory, including group actions and the Sylow Theorems. Additionally, we will delve into ring theory, lattice structures and boolean algebras, and field theory. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn advanced group theory topics including group actions and the Sylow theorems, and apply them to the study of algebraic structures. 2. Apply abstract algebra to real-world technologies such as circuits and error-correcting codes. 3. Construct and verify mathematical proofs, particularly those arising in abstract algebra. 4. Demonstrate an understanding of ring theory, including ideals, quotient rings, homomorphisms, isomorphisms, and polynomial rings. 5. Learn about finite fields, algebraic and transcendental extensions, and Galois theory; and explore their applications. Prerequisite: MATH 4000 (Grade C or higher). SP (odd).

MATH 4100. Introduction to Topology. 3 Hours.
Overview of elementary point-set topology. Includes topological spaces, compactness, connectedness, metric spaces, and Hausdorff spaces. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe concepts of and prove fundamental results in point-set topology as needed for advanced work in the mathematical sciences. 2. Develop the ideas of a topology, basis, the Hausdorff property, connectedness, continuous mappings, compactness, and related concepts. 3. Create new topological spaces using the product topology, subspace topology, and quotient topology. 4. Produce rigorous proofs in the context of topology. Prerequisites: MATH 2210 and MATH 3120 (Grade C or higher). FA (odd).

MATH 4200. Introduction to Complex Analysis. 3 Hours.
Overview of basic theory and applications of complex variables, including analytic functions, contour integration, and conformal mappings. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand arithmetic, algebraic, geometric properties of complex numbers and basic complex functions (mappings). 2. Understand calculus concepts like limit, continuity, and derivatives of elementary complex analytic functions in particular with complex exponential, logarithmic, power, trigonometric, hyperbolic, inverse trigonometric, and inverse hyperbolic functions. Understand how those functions act as mappings of the complex plane. 3. Define integral of complex functions (contour integral). Understand the properties of contour integral and method of evaluation in the complex plane. 4. Understand complex sequences and series including power series, Taylor series, and Laurent series; Implement basic convergent/divergent tests. Understand residual theorem, Laplace transformation, and Fourier Transformation. 5. Understand and utilize conformal mapping to solve boundary-value problems in heat flow, electrostatics, and fluid flow. Prerequisite: MATH 3200. SP (even).

MATH 4250. Programming for Scientific Computation. 4 Hours.
This course introduces the essentials of scientific computer programming using appropriate high-level languages to solve problems in engineering and science. Programming topics include problem decomposition, control structures, recursion, arrays and other data structures, file I/O, graphics, code libraries, round-off error in floating point arithmetic. Applications will be drawn from numerical integration and differentiation, root finding, matrix operations, searching and sorting, simulation, and data analysis. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate proficiency in basic skills related to using MATLAB/Python in scientific computation setting. 2. Apply programming skills to solving challenging problems that are either purely mathematical or arise from other disciplines. Prerequisites: CS 1400 (Grade C or higher) and MATH 2270 (Grade C or higher). Corequisites: MATH 2280. SP.

MATH 4330. Linear Algebra II. 3 Hours.
This course introduces topics of linear algebra needed for advanced applications. Topics included are abstract vector spaces, linear transformations, dual spaces, inner product spaces, orthogonality, bilinear forms, eigenvalues and eigenvectors, generalized eigenvectors, diagonalization, and canonical forms. **COURSE LEARNING OUTCOMES (CLOs) At the successful completion of this course, students will be able to: 1. Demonstrate a thorough understanding of the core concepts and solution techniques of linear algebra. 2. Employ linear algebra in various application areas. 3. Utilize technology and computer algebra systems to aid problem solving. 4. Produce and present work in the form of a course project. Prerequisites: MATH 2270 and MATH 3120 (Both grade C or higher). SP (even).

MATH 4400. Financial Mathematics. 3 Hours.
This course focuses on the theoretical basis and mathematical analysis of financial mathematics. This course prepares actuarial students for exam FM in the Society of Actuaries' series (or Exam 2 for the Casualty Actuarial Society). **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to define and recognize terms regarding time value of money. 2. Solve problem related to time value of money. 3. Define and recognize terms regarding annuity. 4. Solve problem related to loans and bonds. 5. Define and recognize terms regarding immunization. 6. Construct various investment portfolio. 7. Take the Actuarial Financial Mathematics Exam (SOA Exam FM/CAS Exam 2). Prerequisites: MATH 1100 (Grade C or higher) or MATH 1210 (Grade C or higher). SP.

MATH 4410. Actuarial Exam FM/ 2 Preparation. 1 Hour.
Recommend for students to take this class the same semester as MATH 4000. Prepare for Exam FM/2 by working on sample exam questions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate through testing the ability to take the Actuarial Financial Mathematics Exam (SOA Exam FM/CAS Exam 2) Prerequisites: MATH 4400 (Grade C or higher, can be concurrently enrolled). SP.

MATH 4450. Math for Secondary Special Education Teachers. 3 Hours.
Required for all Special Education majors. Teacher candidates will learn content appropriate for secondary students, effective practices, and strategies to support secondary students with disabilities as they learn about mathematics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, plan, and implement learning progressions in mathematics. 2. Identify and implement interventions using a tiered approach. 3. Describe and appropriately plan for social emotional factors related to math learning. 4. Describe and identify effective practices for co-teaching mathematics in the secondary classroom. 5. Demonstrate effective teaching practices in mathematics at the secondary level. Prerequisites: Admission to the Utah Tech University Special Education Program. FA, SP.

MATH 4500. Methods Teach Secondary Math. 3 Hours.
A teaching methods course designed for Math Education majors who aspire to teach mathematics at the secondary school level. It offers practical strategies and methods for effective mathematics instruction in a high school setting. Students will learn how to plan and deliver lessons, develop curriculum, and create assessments. The focus will be on creating an inclusive and equitable learning environment that encourages student engagement with math and helps students build a positive mathematical identity. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Plan and deliver effective, learner-centered math instruction by considering each students needs and strengths, and developing appropriate tasks. 2. Interpret and implement math curricula and standards in the creation of formative and summative assessments that consider students needs, strengths, and course content. 3. Foster student engagement and the promotion of their mathematical identities by valuing each students unique mathematical, cultural, and linguistic contributions. 4. Create a learning environment that encourages diverse mathematical thinking and leverages students funds of knowledge to guide instruction and cultivate confidence. 5. Construct learning opportunities and use planning and implementation practices that provide equitable access, support, and challenges for every student. Prerequisite: MATH 1210 (Grade C or higher). FA.

MATH 4550. Scientific Computation. 3 Hours.
Advanced numerical linear algebra, optimization, nonlinear systems, topics from approximation theory, quadrature, numerical solutions of differential equations. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate an understanding of the concepts of efficiency and stability of algorithms in numerical linear algebra. 2. Understand the importance of matrix factorizations, and know how to construct some key factorizations using elementary transformations. 3. Solve linear systems, least squares problems, and the eigenvalue problems. 4. Appreciate the issues involved in the choice of algorithm for particular problems (sparsity, structure, etc.). 5. Appreciate the basic concepts involved in the efficient implementation of algorithms in a high-level language. Prerequisites: MATH 3500 (Grade C or higher). SP (odd).

MATH 4800. Industrial Careers in Mathematics. 3 Hours.
Students will work in teams on a project from an industrial firm. This course is designed to expose students to the types of problems solved by mathematicians working in business, government, or industry. Students will be given a real-life problem and asked to work on a solution over the course of the semester. Student success will depend on realistic industry evaluations such as teamwork, communication, individual initiative, and final products. Advanced Standing (Math 4800 is a course for students with strong mathematical preparation.) **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Experience how Math is done in the real world. 2. Develop, test, and implement a mathematical model of their own devising. 3. Assess and revise their own results in order to arrive at a solution that meets the practical constraints of the client. 4. Collaborate in small teams working toward a common goal. 5. Improve their communication skills by presenting and clarifying technical results. 6. Become acquainted with non-academic stakeholders in business, industry, and government. 7. Prepare for a potential career in Industrial Mathematics and increase awareness about the growing pool of non-academic careers. Prerequisites: Instructor permission required. SP.

MATH 4890R. Independent Research. 1-3 Hours.
Designed to meet the individual needs of advanced students in the Math Department who wish to perform an independent research to answer a specific mathematical question. This course is offered by arrangement with an individual faculty, based on preparation and interest, and allows close interaction between the student and faculty member to address specific mathematical problems. Projects are at the discretion of the faculty member, in line with the student's interests in the various mathematics subject areas. The student and faculty will set expectations and grading policies at the beginning of the term. Students are expected to meet with the faculty mentor each week and to provide the faculty mentor with progress reports and assignment development for feedback. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Complete an independent research project under faculty supervision. Prerequisite: Instructor permission required. FA, SP, SU.

MATH 4900. Senior Capstone Seminar (ALUR). 3 Hours.
Independent Study. In order to pass this course students must score a 25 or better on the Majors Fields test. Required of all Mathematics majors in the senior year. Emphasizes the ability to analyze and communicate mathematically through projects to include researching topics, summarizing journal articles, using a technical documentation system such as LaTeX or Equation Editor, and making oral class presentations. Preparation for and completion of standardized exit exam is required. This course is designated as an Active Learning Undergraduate Research (ALUR) course. Students will conduct an inquiry or investigation that makes an original intellectual or creative contribution to the discipline. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify research topics and problems of interest to them. 2. Read, interpret, analyze, and possibly expand upon ideas contained in modern mathematical research papers. 3. Write, in the mathematical language, research articles and papers that meet the current stylistic standards for publication within reputable scientific journals. 4. Utilize the TeX/LaTeX typesetting environment and the associated Beamer document class to produce technical and mathematical papers, together with accompanying slideshows that meet the current formatting standards for circulation, dissemination, and presentation within the scientific community. 5. Give well-organized, precise, and compelling oral presentations of their findings. Course fee required. Prerequisite: Senior standing, Mathematics major, and instructor permission required. FA, SP.