# MATHEMATICS (MATH)

**MATH 106. Mathematics for the Benefit of Mission and Society. (4 Credits)**
An overview of how mathematics benefits the mission of the Church and society worldwide, with special regard for those who are suffering and/or marginalized. Examples will be drawn both from history and our contemporary world.
**Tags:** AAQR

**MATH 107. Finite Mathematics and Applications. (4 Credits)**
Designed to provide the mathematical tools that a college graduate is likely to encounter in his or her work. Core topics include systems of linear equations, mathematics of finance, and basic probability and statistics. Additional topics may include game theory for decision making, linear programming, iterated processes, or networks. Extensive use of spreadsheet programs. The course illustrates the relevance of mathematics to life applications by taking real or realistic examples from business, economics, social sciences, and life sciences.
**Tags:** AAQR

**MATH 121. Data Science I. (4 Credits)**
This course combines inferential thinking, computational thinking, and real-world relevance. The course teaches critical concepts and skills in computer programming and statistical inference, in conjunction with hands-on analysis of real-world datasets from a variety of disciplines/industries. The course also covers current ethical issues pertinent to decision-making data. Prerequisite: Precalculus knowledge.
**Tags:** AAQR

**MATH 125. Mathematics for Elementary and Middle Grade Education. (4 Credits)**
Set theory, numeration systems, number theory, and properties of the natural numbers, integers, rational, and real number systems with an emphasis on problem solving and critical thinking. Selected topics from geometry, algebra, probability, and statistics. Satisfies AAQR for Elementary Education majors only. Prerequisite: Elementary Education major.
**Tags:** AAQR

**MATH 131. Precalculus. (4 Credits)**
A course in elementary functions intended to prepare students for MATH 135 or MATH 235. Topics include the properties of the real number system, inequalities and absolute values, functions and their graphs, solutions of equations, polynomial functions, trigonometric functions, exponential, and logarithm functions. Emphasis on using functions to model physical or social systems.
**Tags:** AAQR

**MATH 135. Calculus for Business & Social Sciences. (4 Credits)**
This course covers the ideas of calculus, emphasizing applications to business and the social sciences. Topics include limits, definitions and applications of the derivative and integral, and functions of one or more variables. Three lectures, two hours drill. Prerequisite: MATH 131 or Precalculus competence.
**Tags:** AAQR

**MATH 206. Logic, Sets, and Proofs. (2 Credits)**
Propositional logic, quantifiers, elementary proof techniques and strategies. An introduction to set theory, including operations on sets, definition of functions. Basic number theory including divisibility, greatest common divisor, Euclidean Algorithm. Induction proofs and pigeon-hole principle. Successful completion of a high school pre-calculus course is recommended prior to taking this course. (Open to Wheaton College Summer Institute students only)

**MATH 215. Data Science for the Common Good. (2 Credits)**
Can the power of data science be used to benefit the mission of the Church and society? How do these tools help (or hinder!) causes of justice and equity? This course is both a hands-on introduction to the basics of Python programming for data science—data wrangling, visualization, and statistical methods—as well as a look at how these tools may be used to better understand God's world. No previous programming experience is required. (Open to Wheaton College Summer Institute students only)

**MATH 235. Calculus I. (4 Credits)**
The limit concept. Definitions of the derivative and integral of functions of one variable, with basic properties and applications. Transcendental functions, methods of integration. Three lectures, two hours drill. Prerequisite: Earning 75% on the Calculus Readiness Assessment or MATH 131.
**Tags:** AAQR

**MATH 236. Calculus II. (4 Credits)**
Techniques of integration; applications of integration; infinite sequences and series; parametric equations; and polar curves. Three lectures, two hours drill. Prerequisite: MATH 235 with a minimum grade of C-.

**MATH 237. Calculus III. (4 Credits)**
Three-dimensional analytic geometry; multivariable differential and integral calculus; vector algebra; line integrals and surfaces integrals; Green's, Stokes', and the divergence theorems. Prerequisite: MATH 236.

**MATH 241. Introduction to Proofs. (2 Credits)**
Propositional logic, quantifiers, elementary proof techniques and strategies. An introduction to set theory, including operations on sets, definition of functions, relations. Basic number theory including divisibility, primes, greatest common divider, Euclidean Algorithm. Induction and well-ordering. Permutations and combinations. Axiomatic systems. Prerequisite: MATH 236 . Pre or Corequisite: MATH 245.

**MATH 245. Linear Algebra. (4 Credits)**
Starting with solving systems of linear equations, matrix algebra is used to explore vector spaces and linear transformations. Emphasis is given to bases, dimension, eigenvectors, and orthogonality. Prerequisite: MATH 235 or MATH 236.

**MATH 263. Introduction to Statistics. (4 Credits)**
An introduction to statistics, sampling theory, and statistical decision making from a solid mathematical basis for non-mathematics majors. Topics chosen from discrete and continuous distributions, moments, hypothesis testing, correlation and multiple correlation, regression (linear, multivariate, logistic), ANOVA, contingency tables with tests for independence, sampling theory, and rudimentary non-parametric statistics. Students will use selected software packages for data processing and analysis and will need access to a laptop and a graphing calculator with an inverse t-distribution function. Prerequisite: MATH 131 or Precalculus knowledge.
**Tags:** AAQR

**MATH 301. Intro to Upper-Level Math. (2 Credits)**
Introduction to learning and communication processes used in upper-level mathematics: primary literature sources, presenting mathematics in writing and orally using specialized software. The vocation of a mathematician: ongoing research developments, professional opportunities in academia and in the industry. For sophomore or junior math or applied math majors only. Prerequisite: MATH 236. Pre or Corequisite: MATH 245.

**MATH 302. Applied Project I. (2 Credits)**
Submission of Applied Project proposal. Preliminary draft of research project including problem statement, scope of project, background, design and methodology in consultation with faculty project advisor(s). Prerequisite: MATH 301.

**MATH 314. Problem Solving Seminar. (2 Credits)**
Mathematical problem solving aimed at students who enjoy solving problems in a variety of areas of mathematics, and who would like to strengthen their creative mathematical thinking. Students are required to take the William Lowell Putnam Undergraduate Mathematics Competition. Prerequisite: MATH 236 and MATH 245.

**MATH 324. Methods of Teaching Mathematics. (2 Credits)**
Theories and methods for teaching mathematics at the secondary level. Topics include cooperative learning, classroom management, and creative teaching ideas. Consideration of current math technology and curriculum standards. Required of mathematics majors in WheTEP, prior to student teaching. Prerequisite: Acceptance to WheTEP.

**MATH 325. Methods of Teaching Middle Grade Mathematics. (2 Credits)**
Theories and methods for teaching mathematics at the middle grade level. Topics include effective teaching strategies, planning, and assessment of math content. Based on current state and national content and teaching standards. Prerequisite: EDUC 225, EDUC 225L and Admission into WheTEP.

**MATH 331. Vector Calculus. (2 Credits)**
Vector algebra, properties of transformations, curves and surfaces, line, surface, and volume integrals, Green's, Stokes', and the divergence theorems. Prerequisite: MATH 232 or 234.

**MATH 333. Differential Equations. (4 Credits)**
An introduction into the theory, methods of solution, and selected applications of ordinary differential equations. Topics include first order equations, second order linear equations with constant coefficients, numerical analysis of ordinary differential equations, Laplace Transforms, series solutions, and systems of differential equations. Prerequisite: MATH 236.

**MATH 341. Modern Algebra. (4 Credits)**
An introduction to the theory of groups, rings, and fields. Topics in group theory include Lagrange's theorem, quotient groups, applications to geometry, public key cryptography, and finitely generated abelian groups. Topics in ring theory include ideals, quotient rings, and polynomial rings. Topics in field theory include field extensions, Euclidean construction problems, cubic and quartic equations. Prerequisites: MATH 245 and (MATH 241 or CSCI 243), or consent of instructor.

**MATH 351. Analysis I. (4 Credits)**
Derivation of the properties of continuity, differentiability, integrability, and convergence by use of the limit concept and basic axioms of the real number field. Prerequisite: MATH 236. Pre or Corequisite: MATH 241 or CSCI 243.

**MATH 352. Complex Analysis. (4 Credits)**
An introduction to functions of a complex variable. Topics include the algebra and geometry of complex numbers, mappings of the complex plane, elementary analytic functions, complex functions defined by power series, and differentiation and integration of complex functions. Offered spring of odd-numbered years. Prerequisite: MATH 237 (MATH 351 recommended).

**MATH 362. Geometry. (4 Credits)**
Selected topics from finite, affine, projective, Euclidean and non-Euclidean geometry from both the axiomatic and transformation approaches. Prerequisite: MATH 245. Offered spring of odd-numbered years.

**MATH 363. Probability Theory. (4 Credits)**
An introduction to probability theory, including discrete and continuous distributions. Topics covered include independence, conditional probability, expectation, variance and covariance, random vectors, and the central limit theorem. Students will need access to a non-CAS (Computer Algebra System) graphing calculator with an inverse t-distribution function. Prerequisite: MATH 236 and MATH 245.

**MATH 364. Mathematical Modeling. (4 Credits)**
This applied course teaches mathematical modeling techniques used in the natural and social sciences including discrete and continuous dynamical systems, optimization, stochastic and data-driven models based on statistical methods, regression and interpolation. Analytical and numerical methods are used alongside computer simulations to study models used in biology, ecology, economics, epidemiology, meteorology, pharmacology, sociology, and supply chain logistics. Prerequisite: MATH 236 and MATH 245.

**MATH 385. Topics in Applied Mathematics. (4 Credits)**
A topic selected for each semester in which the course is offered that focuses upon a particular applied mathematics discipline in a way that brings important mathematical theory and methods to practice. Possibilities include MATLAB modeling, Numerical Analysis, Dynamical Systems, Applied Linear Algebra, Operations Research, Cryptography, or Applied Discrete Math. Prerequisite: MATH 236 and MATH 245 or consent of instructor.

**MATH 386. Topics in Statistics. (4 Credits)**
A topic selected for each semester in which the course is offered that focuses upon a particular application in depth and goes beyond methods covered in MATH 363. Some possible topics include Bayesian Analysis, Machine Learning, Nonparametric Methods, Regression, or Structural Equation Modeling. Prerequisite: MATH 363.

**MATH 433. Partial Differential Equations. (4 Credits)**
Partial differential equations (PDE's) are differential equations involving functions of multiple independent variables and partial derivatives. PDEs are ubiquitous in the natural sciences, especially physics and engineering, appearing in mathematical models that vary in time and space such as diffusion, fluid flow, vibrating strings and membranes, waves (sound, electromagnetic), transport phenomena, and quantum mechanics. The course focuses on analytical methods for solving PDEs with extensions into Fourier theory, L2 theory, and Sturm-Liouville theory. Prerequisites: MATH 245 and 333.

**MATH 441. Algebra II. (4 Credits)**
Advanced group theory, including group actions and Sylow theorems. Module theory with selected applications. Galois theory of field extensions. Multivariable polynomial rings with applications of Groebner bases. Introduction to the concept of categories. Prerequisite: MATH 341. Offered fall of even-numbered years.

**MATH 451. Analysis II. (2 or 4 Credits)**
Study of topics from real analysis. Prerequisite: MATH 351. Alternate years.

**MATH 463. Mathematical Statistics. (4 Credits)**
Starting from a review of probability distributions and their underlying assumptions and features, this course focuses upon statistical inference and data analysis. Topics will be chosen from parametric hypothesis testing, ANOVA, contingency tables and tests for independence, regression techniques and some Bayesian/non-parametric methodology. Students will use selected software packages for data processing and analysis and will need access to a laptop (Windows/Mac/Linux OS) as well as to a non-CAS (Computer Algebra System) graphing calculator with an inverse t-distribution function. Prerequisite: MATH 363.

**MATH 464. Bayesian Statistics. (4 Credits)**
Students will study advanced statistical analysis methods from a Bayesian perspective. The course will cover all the fundamental concepts of Bayesian methods, including Bayes Rule, hierarchical models (a.k.a. multilevel models), Markov chain Monte Carlo (MCMC) methods, and the use of STAN as the modeling algorithm. Methods will be applied to various types of data. Inference and model fit measures will be discussed. Prerequisite: MATH 363.

**MATH 465. Applied Machine Learning. (4 Credits)**
An introduction to machine learning that emphasizes application to data. Both supervised and unsupervised methods are discussed, including classification, clustering, regression, and feature selection, along with neural networks/deep learning. Prerequisite: MATH 363.

**MATH 485. Advanced Topics in Mathematics. (4 Credits)**
A topic selected for each semester in which the course is offered that focuses upon a particular applied mathematics discipline in a way that brings important mathematical theory and methods to practice. Possibilities include Numerical Analysis, Dynamical Systems, Applied Linear Algebra, Operations Research, Cryptography, Combinatorics, or Applied Discrete Math. Prerequisite: MATH 236 and MATH 245, or consent of instructor.

**MATH 493. Mentored Research Seminar. (2 or 4 Credits)**
Faculty and student collaboration on a project of mutual interest. Limited enrollment - faculty approval required.

**MATH 494. Senior Seminar. (2 Credits)**
A survey of the history and philosophical foundations of mathematics, and also its current research trends and cultural impact. Students will discuss the diverse vocations of a Christian including their fulfilment of God’s kingdom, equity, and social justice, as well as the stewardship of mathematical ability for the flourishing of society via research, teaching, and industry. Students will also engage in projects involving literature review, creative teaching and problem solving, mathematical models, or statistical analysis. Prerequisites:Senior standing in the mathematics major.
**General Education:** SHAR

**MATH 495. Problems In Mathematics. (1 to 4 Credits)**
Independent study for senior majors. A maximum of two hours can be applied to the major.

**MATH 496. Internship. (1 to 4 Credits)**
Graded pass/fail. Prerequisite: junior or senior standing with Mathematics or Applied Mathematics major.