

MATHEMATICS (MATH)

MATH 000 Math Assessment 0 Credit Hour(s)

Offered: Resident and Online

MATH 100 Fundamentals of Mathematics 3 Credit Hour(s)

Resident Prerequisite: Placement Score-Math with a score of 40 or (CLST 103 and Assessment - Mathematics with a score of 01)

Online Prerequisite: (CLST 103 and Assessment - Mathematics with a score of 01) or Placement Score-Math with a score of 040

A review of basic arithmetic and elementary algebra. A grade of C or better is required in order to go on to a higher-numbered mathematics course. This course may not be used in meeting General Education requirements in mathematics. (Developmental Math is a component of the Bruckner Learning Center.)

Offered: Resident and Online

MATH 100L Fundamentals of Mathematics Companion Lab 1 Credit Hour(s)

Prerequisite: MATH 100 (may be taken concurrently)

Optional Companion Lab for MATH 100. This course is intended to provide extra assistance to students currently enrolled in MATH 100 through synchronous lecture and question/answer sessions.

Offered: Resident and Online

MATH 105 Algebra for the Liberal Arts 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 60 or CLST 103

Review of number systems, solving equations and inequalities, exponents, polynomials, factoring, systems of equations, radicals, and the quadratic formula. This course is designed to prepare students for college-level, general education, liberal arts mathematics and statistics courses.

Offered: Resident

MATH 108 Elementary and Intermediate Algebra 3 Credit Hour(s)

Prerequisite: Assessment - Mathematics with a score of 09 or SAT Section Math with a score of 470 or ACT Math with a score of 17 or (pre2016 post1995)SAT Math with a score of 470

This course is a self-paced computer-based review of rational numbers, exponents, polynomials, factoring, roots and radicals, graphing, rational expressions, equations and inequalities, systems of linear equations, and problem solving. It meets the prerequisite requirements for MATH 115, MATH 117, MATH 121, MATH 125, MATH 201, MATH 217. Credit may not be earned for both MATH 108 and MATH 110. This course may not be used to meet the General Education Requirements. (Developmental Math is a component of the Bruckner Learning Center.)

Offered: Resident

MATH 109 Beginning/Intermediate Algebra 3 Credit Hour(s)

Offered: Resident and Online

MATH 110 Intermediate Algebra 3 Credit Hour(s)

Prerequisite: MATH 100 or Placement Score-Math with a score of 070 or (CLST 103 and Assessment - Mathematics with a score of 23) or MATH 105

Review of exponents, polynomials, factoring, roots and radicals, graphing, rational expressions, equations and inequalities, systems of linear equations and problem solving. This course may not be used to meet the General Education requirement. (Developmental Math is a component of the Bruckner Learning Center.)

Offered: Resident and Online

MATH 110L Intermediate Algebra Companion Lab 1 Credit Hour(s)

Prerequisite: MATH 110 (may be taken concurrently)

Optional Companion Lab for MATH 110. The course is intended to provide extra assistance to students currently enrolled in MATH 110 through synchronous lecture and question/answer sessions.

Offered: Resident and Online

MATH 112 Technical Mathematics 3 Credit Hour(s)

Online Prerequisite: (pre2016 post1995)SAT Math with a score of 490 or SAT Section Math with a score of 490 or ACT Math with a score of 18 or MATH 100

Technical Mathematics presents a review of arithmetic, elements of algebra, geometry, trigonometry, and vectors. Direct applications are made to technical study areas. Only fulfills General Education requirements for AAS degrees.

Offered: Online

MATH 114 Quantitative Reasoning 3 Credit Hour(s)

Prerequisite: MATH 100 or Placement Score-Math with a score of 070 or (CLST 103 and Assessment - Mathematics with a score of 23) or MATH 105

Applying mathematical tools and analysis to practical context, particularly focusing on using proportions and ratios. Basic statistical tools are developed and employed, including graphs, descriptive statistics, the normal curve, the basics of inferential reasoning and investigating correlation. Financial applications are particularly emphasized, as is the use of spreadsheets.

Offered: Resident and Online

MATH 115 Mathematics for Liberal Arts 3 Credit Hour(s)

Resident Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15) or MATH 105 or MATH 108 or MATH 110 or MATH 2XX

Online Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics II with a score of 15 and Assessment - Mathematics with a score of 23) or MATH 105 or MATH 108 or MATH 110 or MATH 2XX

A survey course for liberal arts majors including a review of algebra and an introduction to logic, probability and statistics, mathematical structures, problem solving, geometry and consumer applications.

Offered: Resident and Online

MATH 116 Logic and Social Reasoning 3 Credit Hour(s)

Resident Prerequisite: Placement Score-Math with a score of 075 or Assessment - Mathematics II with a score of 15 or MATH 110 or MATH 114 or MATH 117 or MATH 121 or MATH 122 or MATH 125 or MATH 126 or MATH 128 or MATH 131 or MATH 201 or BUSI 230 or MATH 2XX

Online Prerequisite: Placement Score-Math with a score of 075 or Assessment - Mathematics II with a score of 15 or MATH 110 or MATH 114 or MATH 117 or MATH 121 or MATH 122 or MATH 125 or MATH 126 or MATH 128 or MATH 131 or MATH 201 or BUSI 230 or MATH 1XX or MATH 2XX

A survey course for liberal arts majors including an introduction to logic and various financial math applications. Also covers applications of mathematics to elections, measuring political power, effective ways of sharing goods and services, and apportionment of votes.

Offered: Resident and Online

MATH 117 Elements of Mathematics 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics II with a score of 15 and Assessment - Mathematics with a score of 23) or MATH 108 or MATH 110 or MATH 121 or MATH 126 or MATH 128 or MATH 131 or MATH 2XX

A development of basic concepts of elementary mathematics, including problem solving, logic, sets and binary operations, the natural numbers and their properties, deductive reasoning and the nature of proof, the integers, rational numbers, real numbers and their properties, relations, functions, and graphs.

Offered: Resident and Online

MATH 121 College Algebra 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15) or MATH 108 or MATH 110 or MATH 126 or MATH 128 or MATH 131

Fundamental concepts of college algebra including sets, equations and inequalities, functions and graphs, polynomials, rational functions, exponential and logarithmic functions, linear inequalities, and linear programming.

Offered: Resident and Online

MATH 122 Trigonometry 3 Credit Hour(s)

Prerequisite: MATH 121

Emphasizes the circular functions, their graphs and their inverses. A study of the trigonometric functions and their applications is included.

Offered: Resident

MATH 123 Introduction to Discrete Mathematics 3 Credit Hour(s)**MATH 125 Finite Mathematics 3 Credit Hour(s)**

Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15) or MATH 108 or MATH 110 or MATH 126 or BUSI 128 or MATH 131

An introduction to symbolic logic, principles of counting, elementary probability, matrices, vector spaces, and linear programming.

Offered: Resident

MATH 126 Elementary Calculus for Business and Science 3 Credit Hour(s)

Prerequisite: MATH 121 or ACT Math with a score of 25 or (pre2016 post1995)SAT Math with a score of 570 or SAT Section Math with a score of 590

An introduction to differential and integral calculus with emphasis on applications in the areas of business and science. For non-mathematics majors only.

Offered: Resident and Online

MATH 128 Precalculus with Trigonometry 4 Credit Hour(s)

Prerequisite: McGraw Hill ALEKS PPL with a score of 68 or ACT Math with a score of 25 or (pre2016 post1995)SAT Math with a score of 570 or SAT Section Math with a score of 590 or MATH 121

A pre-calculus course that includes the study of elementary functions, their graphs and applications including polynomial, rational, algebraic functions, exponential, logarithmic and circular or trigonometric functions. For students with strong high school preparation in mathematics but who are not ready for calculus.

Offered: Resident and Online

MATH 130 Advanced Technical Mathematics 3 Credit Hour(s)

Prerequisite: (MATH 110 or Placement Score-Math with a score of 075) and AVIA 102 (may be taken concurrently)

An overview of applied mathematics related to technical fields of study. Topics include a review of the fundamentals of algebra; linear equations and inequalities, quadratic equations; variation; polynomial, rational, exponential, logarithmic and trigonometric functions, use of tables, rectangular and polar coordinates, and vectors.

Offered: Resident

MATH 131 Calculus and Analytic Geometry I 4 Credit Hour(s)

Prerequisite: ((MATH 128 or McGraw Hill ALEKS PPL with a score of 78 or (pre2016 post1995)SAT Math with a score of 620 or SAT Section Math with a score of 620 or ACT Math with a score of 27) and (MATH 121 or (pre2016 post1995)SAT Math with a score of 570 or SAT Section Math with a score of 590 or ACT Math with a score of 25))

Functions and graphs, exponential, logarithmic, inverse trigonometric, limits, the derivative, techniques of differentiation, continuity, applications of differentiation, L'Hopital's Rule, the integral.

Note: (MATH 133 is required for mathematics major or minors).

Offered: Resident and Online

MATH 132 Calculus and Analytic Geometry II 4 Credit Hour(s)

Prerequisite: MATH 131 or ENGR 131

A continuation of MATH 131. Techniques of integration, improper integrals, applications of integration, introduction to differential equations, sequences, infinite series, parameterizations of curves.

Offered: Resident and Online

MATH 133 Calculus with Mathematica Lab 1 Credit Hour(s)

Prerequisite: MATH 131 (may be taken concurrently) or ENGR 131 (may be taken concurrently)

This is intended to be an introductory Mathematica lab in which the topics of arithmetic, algebra, plotting, preparation of notebooks, limits, derivatives, related rates, optimization, integration, and other topics will be investigated.

Offered: Resident

MATH 200 Introduction to Mathematical Reasoning 3 Credit Hour(s)

Prerequisite: MATH 132

This is a course in the principles of mathematical reasoning and the construction of proofs. It begins with the growth of functions, Big-O notation, and symbolic logic and then studies direct and indirect methods and proof by induction. Examples from set theory, discrete structures, axiomatic systems, recursion, and basic algebraic structures (groups, rings, fields) are used to illustrate the methods.

Offered: Resident

MATH 201 Introduction to Probability and Statistics 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 075 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15) or MATH 105 or MATH 108 or MATH 110 or MATH 115 or MATH 116 or MATH 121 or MATH 126 or MATH 128 or MATH 131 or MATH 1XX or MATH 2XX

Introduction to descriptive statistics and probability, probability distributions, estimation, tests of hypotheses, chi-square tests, regression analysis, and correlation with applications in business and science. (Crosslisted with BUSI 230)

Offered: Resident and Online

MATH 202 Professional Statistics 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 75 or MATH 110 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15)
This course provides a foundation in elementary statistics that facilitates data interpretation and statistical analysis.
Offered: Resident and Online

MATH 211 Introduction to Statistical Analysis 3 Credit Hour(s)

Prerequisite: MATH 131
An introduction to statistical analysis for students with a background in calculus. Includes probability theory, probability distributions, expectation, statistical inference, regression and correlation.
Note: Only one of MATH 201 or 211 may be taken for credit. MATH 201 may not be substituted for MATH 211 degree completion program requirement.
Offered: Resident and Online

MATH 217 Elementary Geometry 3 Credit Hour(s)

Prerequisite: Placement Score-Math with a score of 75 or (CLST 103 and Assessment - Mathematics with a score of 23 and Assessment - Mathematics II with a score of 15) or MATH 108 or MATH 110 or MATH 121 or MATH 126 or MATH 128 or MATH 131
A development of basic concepts of elementary geometry including area, volume, compass and straight-edge constructions, polyhedra, tessellations, motions in the physical world, transformations, congruence and similarity.
Offered: Resident and Online

MATH 221 Applied Linear Algebra 3 Credit Hour(s)

Prerequisite: MATH 132
An elementary introduction to the essentials of linear algebra for SECS majors. Systems of linear equations and matrices, determinants, Euclidean vector spaces, eigenvectors, least-squares data fitting, diagonalization and numerical methods.
Offered: Resident

MATH 231 Calculus and Analytical Geometry III 4 Credit Hour(s)

Prerequisite: MATH 132
Continuation of MATH 132. Geometry of vectors, paths, curvature, functions of several variables, graphs and parametric surfaces, partial derivatives, optimization, multiple integrals, curl, divergence, gradient, line and surface integrals, Theorems of Green, and Stokes, and Gauss.
Offered: Resident

MATH 250 Introduction to Discrete Mathematics 3 Credit Hour(s)

Prerequisite: MATH 121 or MATH 128 or MATH 131 or ENGR 131
Logic and proofs, set theory, Boolean algebra, functions, sequences, matrices, algorithms, modular arithmetic, mathematical induction and combinatorics.
Offered: Resident and Online

MATH 299 Internship 0 Credit Hour(s)

Offered: Resident

MATH 301 Methods of Operations Research 3 Credit Hour(s)

Prerequisite: MATH 311 or ENGR 210
Optimization (linear programming, Lagrange multipliers, etc.), transportation problems, applied probability (queuing theory, Markov chains, elementary theory of simulations), theory of games, decisions under uncertainty.
Offered: Resident

MATH 302 Introduction to Experimental Design in Statistics 3 Credit Hour(s)

Prerequisite: MATH 311 or ENGR 210
Analysis of variance and block designs; simple linear regression, correlation and multiple regression; nonparametric statistics, chi-square tests.
Offered: Resident

MATH 304 Financial Mathematics 3 Credit Hour(s)

Prerequisite: MATH 132
An introduction to the concepts of interest theory, with particular emphasis on the mathematics, with actuarial applications. Time value of money, annuities and cash flows, loans, bonds, portfolios, and immunization.
Offered: Resident

MATH 305 Modern Geometry 3 Credit Hour(s)

Prerequisite: MATH 200
A treatment of the foundations of modern Euclidean geometry and an introduction to non-Euclidean geometry with emphasis on hyperbolic geometry. Especially recommended for prospective high school mathematics teachers. Required for Virginia Licensure.
Offered: Resident

MATH 307 Introductory Number Theory 3 Credit Hour(s)

Prerequisite: MATH 200 or MATH 250
Divisibility, Division Algorithm, Euclidean algorithm, primes, greatest common divisor, Diophantine equations, congruencies, Chinese Remainder Theorem, number-theoretic functions, cryptology and other applications.
Note: This course will not be offered online, but will be made available to online students.
Offered: Resident and Online

MATH 311 Probability and Statistics I 3 Credit Hour(s)

Prerequisite: MATH 132
Probability concepts, moment generating functions, discrete and continuous distributions, bivariate distributions, distributions of functions of random variables. (Formerly MATH 401)
Offered: Resident

MATH 321 Linear Algebra 3 Credit Hour(s)

Prerequisite: MATH 200 and MATH 221
A beginning course in linear algebra and its applications. Includes systems of linear equations, linear programming, nullspace and rank of matrices, determinants, abstract vector spaces, bases, linear independence, spanning sets, linear transformations, characteristics and minimal polynomials, eigenvalues and eigenvectors, diagonalization, similarity, coordinate change, orthogonality, and matrix factorizations. Applications are added as time permits.
Offered: Resident

MATH 331 Complex Variables 3 Credit Hour(s)

Prerequisite: MATH 231
Field of complex numbers, polar representation and DeMoivre formula, complex functions, limits, continuity, differentiation, analytic and harmonic functions, elementary functions, contour integration, Taylor and Laurent series, residues, and applications.
Offered: Resident

MATH 332 Advanced Calculus 3 Credit Hour(s)**Prerequisite:** MATH 231 and (MATH 200 or MATH 250)

Euclidean topology for n -dimensions, continuity and differentiability for vector-valued functions of several variables, the differential and derivative, Jacobian, applications of inverse and implicit function theorems, method of Lagrange multipliers, introduction to differential forms, generalized Stokes' Theorem and applications.

Offered: Resident**MATH 334 Differential Equations 3 Credit Hour(s)****Prerequisite:** MATH 231 and PHYS 231

Differential equations of the first order and first degree, linear equations, variation of parameters, methods of undetermined coefficients, inverse operators, Laplace transforms, systems of differential equations, and applications.

Offered: Resident**MATH 345 Introduction to the History of Mathematics 3 Credit Hour(s)****Online Prerequisite:** MATH 301 or MATH 302 or MATH 305 or MATH 307 or MATH 311 or MATH 321 or MATH 331 or MATH 332 or MATH 334 or MATH 350 or MATH 352 or MATH 400 or MATH 401 or MATH 405 or MATH 411 or MATH 419 or MATH 420 or MATH 421 or MATH 422 or MATH 423 or MATH 431 or MATH 450 or MATH 495 or MATH 497

This course covers major events in the evolution of mathematical thought from ancient times to the present.

Offered: Online**MATH 350 Discrete Mathematics 3 Credit Hour(s)****Prerequisite:** MATH 200 or MATH 250

Recurrence relations, relations, graph theory, languages, grammars, and finite-state machines.

Offered: Resident and Online**MATH 352 Numerical Analysis 3 Credit Hour(s)****Prerequisite:** MATH 321 or MATH 221

Introduction to numerical techniques for problems such as interpolation, approximation, numerical differentiation and integration, differential equations, zeros of functions, solutions of linear systems, and error analysis.

Offered: Resident**MATH 400 History of Mathematics 3 Credit Hour(s)****Prerequisite:** MATH 301 or MATH 302 or MATH 305 or MATH 307 or MATH 321 or MATH 331 or MATH 332 or MATH 334 or MATH 350 or MATH 401

The development of mathematics from ancient to modern times (19th century BC-19th century AD). Special emphasis is given to the period of the Greeks (600 BC - 200 AD), the development of the calculus (17th century), and the "modern" period (19th century).

Offered: Resident**MATH 401 Introduction to Mathematical Statistics 3 Credit Hour(s)****Prerequisite:** MATH 211 and MATH 231

Probability concepts, moment generating functions, discrete and continuous distributions, bivariate distributions, distributions of functions of random variables, estimation.

Offered: Resident**MATH 402 Linear Regression 3 Credit Hour(s)****Prerequisite:** MATH 211 or MATH 311 or ENGR 210

A study of linear regression and generalized linear models. Simple and multiple linear regression, residual analysis, linearization and variance stabilization transformations, polynomial models, variable selection, and generalized linear models, utilizing technology in all solutions.

Offered: Resident**MATH 405 Fundamentals of Modern Geometry 3 Credit Hour(s)****Online Prerequisite:** MATH 250

A treatment of the foundations of modern Euclidean geometry and an introduction to non-Euclidean geometries with emphasis on hyperbolic geometry. The course focuses on demonstrating and explaining geometric concepts through axiomatic methods.

Offered: Online**MATH 410 Matrix and Linear Algebra 3 Credit Hour(s)****Online Prerequisite:** ((MATH 250 or Discrete Math-MATH250 with a score of 5) and MATH 132)

Develop an understanding of vector spaces, systems of linear equations, matrix algebra and linear transformations.

Registration Restrictions: BS Applied Statistics students will have MATH 250 prerequisite overridden**Offered:** Online**MATH 411 Probability and Statistics II 3 Credit Hour(s)****Prerequisite:** MATH 311

Descriptive statistics, point and interval estimation, sample size, regression, hypothesis testing, goodness of fit, analysis of variance.

Offered: Resident**MATH 419 Teaching Mathematics in Secondary Schools 3 Credit Hour(s)****Prerequisite:** (MATH 301 or MATH 302 or MATH 305 or MATH 321 or MATH 331 or MATH 332 or MATH 334 or MATH 350 or MATH 401) and Undergraduate Initial Gate 2 with a score of 5 and (Background Check Clearance with a score of 5 or Background Clear International with a score of 5 or Background Clear Out of State with a score of 5 or Background Clear Virginia with a score of 5)

Special readings in the field of Mathematics Education, planning for mathematics instruction, and evaluation components of this course. May not be counted toward the Mathematics major.

Registration Restrictions: Admission to the Teacher Licensure Program
Note: Must be taken the semester prior to student teaching in mathematics.**Offered:** Resident and Online**MATH 420 Teaching Mathematics in Secondary Schools Practicum 0 Credit Hour(s)****Prerequisite:** MATH 419 (may be taken concurrently) and Undergraduate Initial Gate 2 with a score of 5 and (Background Check Clearance with a score of 5 or Background Clear International with a score of 5 or Background Clear Out of State with a score of 5 or Background Clear Virginia with a score of 5)

As the students are developing proficiency in planning for mathematics instruction, evaluating and learning, they will also gain practical experiences by delivering instruction in a peer setting and/or regular school setting with videotaping. Each presentation is to be critiqued by the "teacher," the course instructor and the student peers.

Offered: Resident**MATH 421 Elementary Abstract Algebra I 3 Credit Hour(s)****Prerequisite:** MATH 321

Elementary number theory, the theory of groups, sets and mappings, isomorphisms and homomorphisms of groups, the first isomorphism theorem, and a brief introduction to rings.

Offered: Resident**MATH 422 Elementary Abstract Algebra II 3 Credit Hour(s)****Prerequisite:** MATH 421

A continuation of MATH 421. The theory of rings and fields, integral domains, and the theory of polynomials.

Offered: Resident

MATH 423 Abstract Algebraic Structures 3 Credit Hour(s)**Online Prerequisite:** MATH 321 or MATH 410

This course focuses on developing an understanding of basic algebraic concepts and the structures of groups, rings, fields and homomorphisms through both examples and proofs.

Offered: Online**MATH 430 Multivariable Calculus 3 Credit Hour(s)****Online Prerequisite:** MATH 132 and MATH 250

Develop an understanding of multivariate calculus, its structure, and applicability to functions and analytic geometry.

Offered: Online**MATH 431 Real Analysis 3 Credit Hour(s)****Prerequisite:** MATH 231 and MATH 321

The real number system, sets and cardinality, topology of the real numbers, sequences and series, limits, continuity, uniform continuity and convergence, differentiation, and Riemann integration.

Offered: Resident**MATH 432 Applied Differential Equations 3 Credit Hour(s)****Online Prerequisite:** MATH 231 or MATH 430

Selected topics in differential equations for applied mathematics.

Offered: Online**MATH 441 Probability I 3 Credit Hour(s)****Online Prerequisite:** MATH 132

Set notation and operations, properties of probability, expectation, and discrete and continuous probability distributions of a single random variable.

Offered: Online**MATH 442 Probability II 3 Credit Hour(s)****Online Prerequisite:** MATH 441

Bivariate and multivariate probability distributions, functions of random variables, order statistics, risk and insurance, and foundations of an actuarial career. This course, when combined with Math 441, provides general coverage of all topics on SOA Exam P/CAS Exam 1.

Offered: Online**MATH 450 Mathematics Capstone Seminar 2 Credit Hour(s)****Prerequisite:** MATH 402 (may be taken concurrently) or MATH 421 (may be taken concurrently) or MATH 431 (may be taken concurrently)

Integrate previous mathematical coursework and prepare and present mathematical research, both orally and in written form. Consider the relevance of the Christian worldview and a Biblical ethical approach to the fields of science, mathematics and technology. Introduction to professional and graduate opportunities available to mathematics graduates.

Offered: Resident**MATH 460 Mathematical Modeling and Simulation 3 Credit Hour(s)****Online Prerequisite:** MATH 334 or MATH 432

Formulation, analysis & critique of methods of mathematical modeling.

Offered: Online**MATH 491 Computational Mathematics Capstone 3 Credit Hour(s)****Online Prerequisite:** MATH 432

Senior level capstone for Computational Mathematics.

Registration Restrictions: Senior status**Offered:** Online**MATH 495 Directed Research 1-3 Credit Hour(s)**

Exploration of a topic beyond that covered in any core course as preparation for graduate level mathematics or a professional career. It may be taken for credit more than once.

Registration Restrictions: Approval by department chairman**Offered:** Resident**MATH 497 Special Topics in Mathematics 1-3 Credit Hour(s)****Offered:** Resident