# MATHEMATICS (MATH)

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**MATH 100 Fundamentals of Mathematics**

- **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.)

**MATH 108 Elementary and Intermediate Algebra**

- **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, 117, 121, 125, 201, 217. Credit may not be earned for both MATH 108 and 110. This course may not be used to meet the General Education Requirements. (Developmental Math is a component of the Bruckner Learning Center.)

**MATH 114 Quantitative Reasoning**

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

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.

**MATH 115 Mathematics for Liberal Arts**

- **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 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.

**MATH 116 Logic and Social Reasoning**

- **Resident 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 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.

**MATH 117 Elements of Mathematics**

- **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 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

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.

**MATH 121 College Algebra**

- **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 or MATH 2XX

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.
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)
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 Elementary Functions and Coordinate Geometry 4 Credit Hour(s)
Prerequisite: 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 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 and Online

MATH 131 Calculus and Analytic Geometry I 4 Credit Hour(s)
Prerequisite: MATH 128 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
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
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 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 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)
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 and ENGR 133
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 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
Divisibility, Division Algorithm, Euclidean algorithm, primes, greatest common divisor, Diophantine equations, congruencies, Chinese Remainder Theorem, number-theoretic functions, cryptography and other applications.
Offered: Resident

MATH 311 Probability and Statistics I 3 Credit Hour(s)
Prerequisite: MATH 231
Probability concepts, moment generating functions, discrete and continuous distributions, bivariate distributions, distributions of functions of random variables. (Formerly MATH 401)
Offered: Resident

MATH 312 Probability and Statistics II 3 Credit Hour(s)
Prerequisite: MATH 311
Continuation of MATH 311. Theory of sampling, estimation, hypothesis testing, variance reduction, linear regression, multiple regression, analysis of variance, non-parametric statistics, and applications.
Offered: Resident

MATH 314 Real Analysis 3 Credit Hour(s)
Prerequisite: MATH 301
Rigorous treatment of the real number system, sequences and series, continuity, differentiation, and integration of functions of a single variable.
Offered: Resident

MATH 321 Linear Algebra 3 Credit Hour(s)
Prerequisite: MATH 200
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 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 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 2 Credit Hour(s)
Prerequisite: (MATH 301 or MATH 302 or MATH 305 or MATH 321 or MATH 331 or MATH 332 or MATH 350 or MATH 401) and Education Teacher Licensure 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

MATH 420 Teaching Mathematics in Secondary Schools Practicum 1 Credit Hour(s)
Prerequisite: MATH 419 (may be taken concurrently) and Education Teacher Licensure 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 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 450 Mathematics Capstone Seminar 1 Credit Hour(s)
Prerequisite: MATH 421 (may be taken concurrently) and MATH 431 (may be taken concurrently) and (RSCH 201 or Inquiry Research with a score of 80 or Research with a score of 80 or Research (prior to 2017-2018) with a score of 80)
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 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)
MATH 497 - Special Topics in Mathematics (1 to 3 hours)
Offered: Resident