Courses marked as additive credit are considered credit-bearing for the purposes of financial aid, tuition, and the determination of full-time student status, but do not count toward graduation credits.

MAT 095/Intermediate Algebra   **0.5 unit (additive credit)**
(every semester)   **(does not count towards graduation)**
Prerequisites: See http://mathstat.pages.tcnj.edu/courses-2/calculus-requirement for details.
This course is designed for students majoring in a field where at least one of the courses, Pre-Calculus (MAT 096), Calculus A (MAT 127), or Calculus for Business and the Social Sciences (MAT 125) is required. Conceptual understanding and skill development of traditional algebraic topics such as: linear equations and inequalities, exponents and polynomials, rational expressions, quadratic equations, and systems of linear equations are included.

MAT 096/Pre-Calculus   **0.5 unit (additive credit)**
(every semester)   **(does not count towards graduation)**
Prerequisite: MAT 095 or placement into MAT 096. See http://mathstat.pages.tcnj.edu/courses-2/calculus-requirement for details.
This course is designed for students majoring in a field where at least one of the courses, Pre-Calculus (MAT 096), Calculus A (MAT 127), or Calculus for Business and the Social Sciences (MAT 125) is required. Fundamentals of algebra, trigonometry, and analytic geometry. Stress is on computational and problem-solving techniques.

MAT 099/Orientation to Mathematics and Statistics   **0 course units**
(seven weeks long, every semester)
Required as an entry course of all entering first year students enrolled in majors offered by the Department of Mathematics and Statistics. Topics covered include degree requirements, general information about the college and services offered, career opportunities in mathematics and statistics, academic standards and integrity, study habits and time management, and resume development. General and personal advisement relative to pursuit of the major and the degree is also included.

MAT 101/Applied Liberal Arts Mathematics   **1 course unit**
(every semester)
A liberal arts course covering applied topics in modern mathematics. Topics include graph theory, coding, voting and social choice, and game theory.

MAT 102/Mathematics for the Liberal Arts   **1 course unit**
(every semester)
A liberal arts course covering topics in modern mathematics. Topics include logic, sets, combinatorial probability, abstract mathematical systems, and number theory.

MAT 105/Mathematical Structures and Algorithms for Educators I   **1 course unit**
(every semester)
Prerequisite: Reserved for School of Education students
This course concerns the development of number systems, algebraic structures, and algorithms. The student will be required to reason mathematically, solve problems, and communicate mathematics effectively at different levels of formality, using a variety of representations of mathematical concepts and procedures. Physical materials and models will be used to explore fundamental properties of number systems, to model algorithms, and to explore selected algebraic structures. This course is especially appropriate for those students preparing to be elementary, early childhood, deaf and hard of hearing, or special education teachers.

MAT 106/Mathematical Structures and Algorithms for Educators II   1 course unit
(every semester)
Prerequisite: Reserved for School of Education students
Physical materials and models will be used to explore fundamental concepts of geometry, measurement, data analysis, statistics, and probability. The student will be required to reason mathematically, solve problems, and communicate mathematics effectively at different levels of formality, using a variety of representations of mathematical concepts and procedures. This course is especially appropriate for those students preparing to be elementary, early childhood, deaf and hard of hearing, or special education teachers.

MAT 111/Number Theory and Systems for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of numbers and operations. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation for more formal work in number theory will be integrated with the mathematics content.

MAT 112/Data Analysis and Problems for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of data analysis and probability. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation for more formal work in data analysis and probability will be integrated with the mathematics content.

MAT 114/Patterns, Functions and Algorithms for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of patterns, functions, and algebra. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation for more formal algebraic work will be integrated with the mathematics content.

MAT 115/Geometry for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of geometry. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation for more formal work in geometry will be integrated with the mathematics content.

MAT 117/Discrete Math for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of discrete mathematics. Physical materials, models, technology, and middle school curricula will be used to explore these topics. Exploration of ways to engage middle school students meaningfully in

experiences that lay a strong foundation for more formal work in discrete math will be integrated with the mathematics content.

MAT 118/Concepts of Calculus for Middle School Teachers   1 course unit
(occasionally)
Prerequisite: MAT 105 or MAT 106
This course gives the middle school mathematics teacher a deeper understanding of mathematics through the study of calculus. Physical materials, models, technology, and middle school curricula will be used to explore the topics. Exploration of ways to engage middle school students meaningfully in experiences that lay a strong foundation of the ideas of calculus will be integrated with the mathematics content.

MAT 125/Calculus for Business and the Social Sciences   1 course unit
(every semester)
Prerequisite: MAT 096 or an SAT math score at least 650 See
http://mathstat.pages.tcnj.edu/courses-2/calculus-requirement for details.
This course provides students with a solid grounding in the main aspects of calculus. The course is designed for students in the Social Sciences and the School of Business. Topics include the major aspects of differential and integral calculus, some multivariable calculus, and the uses to which these are put. It differs from MAT 127 (the calculus course for science, mathematics and engineering majors) in that there is less focus on theory, more focus on business applications, and a narrower range of topics. In particular, MAT 125 does not cover trigonometric, inverse trigonometric or hyperbolic trigonometric functions, which are covered in MAT 127, and MAT 127 does not necessarily cover topics such as marginal cost/profit or continuous interest which are covered in MAT 125.

MAT 127/Calculus A   1 course unit
(every semester)
Prerequisite: MAT 096 or an SAT math score at least 650. See
http://mathstat.pages.tcnj.edu/courses-2/calculus-requirement for details.
Provides students with a solid grounding in single-variable calculus. The course is designed for students in the mathematical and physical sciences. Topics include functions and limits, derivatives and differentiation rules, applications of derivatives, and an introduction to integrals and their applications.

MAT 128/Calculus B   1 course unit
(every semester)
Prerequisite: MAT 127, or 125 (with permission of the department chair)
A second course in calculus covering integral calculus and series. The course will cover both the theoretical and applied aspects of calculus.

MAT 150/Classical Mathematics of the Mediterranean Region   1 course unit
(occasionally)
An introduction to the foundations of modern mathematics for non-science majors. Students will develop a deep understanding of the changing perspectives of mathematics and master a number of ancient techniques and forms of reasoning. The course will present the historical context of the mathematics and how it contributed to the development of western thought.

MAT 170/Topics in Mathematics   1 course unit
(occasionally)

MAT 200/Proof Writing through Discrete Mathematics   **1 course unit**
(every semester)
Prerequisite: MAT 096
The course will cover the following specific topics: mathematical notation, logic, truth tables, direct proofs, indirect proofs, proof by contradiction, proof by cases, mathematical induction (weak and strong), contrapositive proofs, definitions and properties of functions and relations, cardinality, proofs of one-to-one and onto properties, proofs of set equality, and a brief introduction to graph theory. In addition to teaching logic, functions, and relations, instructors will teach proof with examples taken from three to four areas of discrete mathematics including set theory, number theory, sequences and recursion, and a fourth area at the discretion of the instructor. However, the main goal of the course is student mastery of proof techniques and not an exhaustive coverage of topics from discrete mathematics.

MAT 205/Linear Algebra: Theory and Applications   **1 course unit**
(every semester)
Prerequisite: MAT 128 or MAT 200 or CSC 270
An introduction to vector spaces and systems of linear equations essential for the understanding of both pure and applied mathematics. Selected topics include: systems of linear equations, matrices, linear transformations, linear independence, determinants, vector spaces, eigenvalues and eigenvectors, and orthogonality. This course includes a lab component using MatLab.

MAT 229/Multivariable Calculus   **1 course unit**
(every semester)
Prerequisite: MAT 128
Topics include: geometry of three dimensional space, derivatives of functions of several variables, integrals in dimension two and three, and Stokes' theorem.

MAT 255/Perspectives on the Development of Mathematics   **1 course unit**
(every fall)
Prerequisite: Reserved for math education students
The course develops a skeletal outline of the history of mathematics. Additional topics may include the history of a specific area of mathematics. Samples of topics that may be covered in the course are: ancient mathematics, the relation between Greek and Mesopotamian algebra, the growth of trigonometric ideas, the geometric solution of the cubic equations by Omar Khayyam and the algebraic solutions by Cardano, Zeno's paradox and the development of different number systems.

MAT 270/Topics in Mathematics   **1 course unit**
(occasionally)
Special topics in mathematics that will vary by semester.

MAT 291/Independent Study in Mathematics   **variable course units**
(every semester)
Prerequisite: Department permission.
For individual pursuit of topics within or beyond a student's major field of study which transcend the regularly available curriculum.

MAT 292/Guided Study in Mathematics   **variable course units**
(every semester)
Prerequisite: Department permission.
This course allows student to study some mathematical topics under the supervision of a faculty member.

MAT 301/Number Theory   **1 course unit**
(every semester)
Prerequisite: MAT 200
Divisibility, primes, unique factorization, diophantine equations, congruences, quadratic reciprocity, and such optional topics as sums of squares, number-theoretic functions, continued fractions, prime number theory, public-key encryption, and elliptic curves.

MAT 305/Abstract Algebra   **1 course unit**
(every semester)
Prerequisites: MAT 200 and MAT 205
An introduction to groups, rings, integral domains and fields. Additional topics include groups of symmetries, rings of integers, rings of polynomials and construction of the field of rational numbers.

MAT 310/Real Analysis   **1 course unit**
(every fall)
Prerequisites: MAT 200 and MAT 229
A logical development of mathematical analysis for functions of a single real variable. Topics include order, completeness, sequences, series, limits of functions, basic topology of the reals, differentiation, integration, sequences and series of functions and transcendental functions.

MAT 315/Topics in Linear Algebra   **1 course unit**
(occasionally)
Prerequisite: MAT 205
The course consists of a collection of topics not covered in MAT 205 and builds upon the material covered in MAT 205. Such topics may include: the Spectral Theorem of Symmetric Matrices, Quadratic Forms, Unitary and Hermitian Matrices, Jordan Canonical Forms, Schur's Theorem, applications to Linear Programming and Markov chains.

MAT 316/Probability   **1 course unit**
(every semester)
Prerequisites: MAT 200; prerequisite or corequisite: MAT 229
An introduction to probability. Topics include mathematical models, sample spaces, conditional probability, discrete and continuous distributions, expected values, moment-generating functions, Central Limit Theorem, multivariate distributions, marginal distributions, conditional distributions, correlation, and one-variable transformations of variables.

MAT 317/Linear Programming   **1 course unit**
(occasionally)
Prerequisites: MAT 127 or MAT 125, and MAT 205
This course studies the optimization of linear functions with constraints. Its methods are widely used in mathematical modeling. The course provides an introduction to the algorithms, theoretical foundations, and applications of linear programming. Selected topics include: the simplex method for solving a linear program (LP), the geometry of LPs, variants of the simplex method, constructing mathematical models using LPs, duality theory, sensitivity analysis, integer programming, transportation and trans-shipment models, network models, program management models, and solving LPs using modern software packages.

MAT 318/Mathematical Statistics   **1 course unit**
(every fall)
Prerequisites: STA 215 and MAT 316
Topics include: theory of sampling, law of large numbers, central limit theorem, normal approximation to binomial and Poisson distributions, estimation of population parameters, hypothesis testing, confidence methods, change of variable and order statistics.

MAT 320/Complex Analysis   **1 course unit**
(every spring)
Prerequisite: MAT 229
A logical development of the classical theory of functions of a complex variable, with emphasis on those parts of the theory which are most used in modern applications of the subject. Topics include: complex numbers, analytic functions, the exponential, trigonometric, hyperbolic, and logarithmic functions and their inverses; mapping by elementary functions; integrals; the Cauchy-Goursat theorem, the Cauchy integral formula, derivatives of analytic functions; the fundamental theorem of algebra; power series; residues and poles; and isolated, essential, and removable singularities.

MAT 326/Differential Equations   **1 course unit**
(every semester)
Prerequisite: MAT 128 and *Corequisite:* MAT 205 or PHY 306
Differential equations are used to model the world around us. Understanding the properties of solutions to differential equations is fundamental to the field of applied mathematics. This course provides an introduction to the theory, solution techniques, and application of ordinary differential equations. Topics may include: solutions to first-order linear and nonlinear ordinary differential equations by analytical, qualitative and numerical methods; existence and uniqueness theorems; solutions to second-order linear differential equations; power series solutions of differential equations; Laplace transform methods; mathematical modeling with differential equations; systems of differential equations including the connection to linear algebra, stability theory and phase plane analysis.

MAT 330/Mathematical Biology   **1 course unit**
(fall of even years)
Prerequisites: MAT 128 and an interest in biology
In this course, we will focus on building and analyzing dynamic mathematical models (models that study how processes change in time) to understand the behavior of different biological systems. We will use mathematical tools like difference equations, differential equations, linear algebra and nonlinear analysis to study these biological processes.

MAT 331/Numerical Methods   **1 course unit**
(fall of odd years)
Prerequisites: MAT 128 and MAT 205
Numerical Methods is a course which focuses on methods of approximating solutions to problems for which the techniques of the earlier Calculus and Linear Algebra courses fail. A course covering methods of approximation, errors in approximation, and efficiency of algorithms.

MAT 351/Geometry   **1 course unit**
(every semester)
Prerequisites: MAT 200 and MAT 229
Both Euclidean and non-Euclidean geometries are studied. Each geometry will be understood from three different perspectives: first, as the collection of theorems following from a particular set of axioms; second, as the two-dimensional geometry arising from a particular metric; and third, as the geometry obtained from a set together with a specific group of rigid motions of the set. At least one of these viewpoints will be developed in detail.

MAT 370/Topics in Mathematics   **1 course unit**
(occasionally)
Special topics in mathematics that will vary by semester.

MAT 391/Independent Study in Mathematics   **variable course units**
(every semester)
For individual pursuit of advanced topics within or beyond a student's major field of study which transcend the regularly available curriculum.

MAT 392/Guided Study in Mathematics   **variable course units**
(every semester)
This course allows student to study mathematical topics under the supervision of a faculty member.

MAT 393/Independent Research in Mathematics   **variable course units**
(every semester)
Prerequisite: By invitation only
Student will study and/or do research independently in an appropriate area. A department member will be assigned to advise and direct the student.

MAT 399/Internship in Mathematics   **variable course units**
(every semester)
Prerequisites: Junior standing and permission of the department.
Applied experience in major field of study. Consult department for details.

MAT 403/Advanced Calculus   **1 course unit**
(occasionally)
Prerequisite: MAT 229
The calculus of several variables is explored from the point of view of the geometry of surfaces in Euclidean space. The emphasis will be on examples rather than proofs. Topics will include the topology of Euclidean Space, the derivative as a linear map, the geometry of maps whose derivative have maximal rank, and Lie groups such as SL (2,R)

MAT 405/Topology   **1 course unit**
(occasionally)
Prerequisite: MAT 305
Students will gain acquaintance of various aspects of topology and its connections to analysis and algebra. This will include a thorough treatment of those aspects of point-set topology that lay the foundation for graduate study; i.e., continuity, compactness, connectedness and separation axioms. Also, this course will introduce students to manifold theory, including the classification of two-dimensional manifolds. The student will understand the role of topological invariants in the classifying topological spaces. This will lead to the classification of the surfaces. Lastly, students will see categorical relationships between topological objects and algebraic objects.

MAT 407/Projective Geometry   **1 course unit**
(occasionally)
Prerequisite: MAT 305
An introduction to projective geometry. Topics include affine and projective plane, real projective plane, principle of duality, groups of automorphisms, and projective planes over division rings.

MAT 440/Mathematical Logic   **1 course unit**
(occasionally)
Prerequisites: MAT 200, a 300-level MAT course and reserved for juniors and seniors.
The process, characteristics, and limits of logical reasoning. Several logical languages will be developed from first principles. Students will become familiar with theorems on consistency and

independence and develop an appreciation of Godel's incompleteness theorem. An introduction to set theory will be included to discuss infinite cardinals.

MAT 451/Seminar in Algebra   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 305
A flexible course in which the content is selected from topics in algebra. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.

MAT 452/Seminar in Geometry and Topology   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 305
A flexible course in which the content is selected from topics in geometry and topology. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.

MAT 453/Seminar in Analysis   1 course unit
(occasionally)
Prerequisites: MAT 229 and MAT 310
A flexible course in which the content is selected from topics in analysis. This is an elective course designed to enrich the background of the student as well as to bridge the gap between undergraduate math and graduate math.

MAT 454/Seminar in Applied Mathematics   1 course unit
(occasionally)
Prerequisites: MAT 326
A flexible course in which the content is selected from topics in applied mathematics. This is an elective course designed to enrich the background of the students as well as to bridge the gap between undergraduate math and graduate math.

MAT 470/Topics in Mathematics   1 course unit
(occasionally)
Advanced special topics in mathematics that will vary by semester.

MAT 492/Guided Study in Mathematics II   variable course units
(every semester)
Prerequisite: Department permission. This course allows student to study advanced mathematical topics under the supervision of a faculty member.

MAT 493/Independent Research II in Mathematics   variable course units
(every semester)
Prerequisite: By invitation only
Student will study and or do research independently in an appropriate area. A department member will be assigned to advise and direct the student.

MAT 494/Independent Study in Mathematics II   variable course units
(every semester)
The course allows students to study advanced mathematical topics independently under the supervision of a faculty member.

MAT 498/Capstone   **1 course unit**
(every spring)
Prerequisites: Senior standing and a Mathematics major. Applied Mathematics specialization students must have completed MAT 310, MAT 326, CSC 220 or CSC 250, and four math options at the 300/400 level. Liberal Arts Mathematics specialization students must have completed MAT 128, 200, 205, 229, 305, 310, and at least one 400-level math option. Intensive study of advanced topics in mathematics. Students will write and present an expository paper in mathematics.