

MATHEMATICS COURSE DESCRIPTIONS

MATH 100: INTRODUCTION TO QUANTITATIVE REASONING (4)*

This course is for students who need practice in applying fundamental mathematical skills (algebra, graphing, geometry, data analysis, and linearity) to real-life applications. The goal of the course is to develop the quantitative skills that promote problem solving with confidence. Open to first-year students. Prerequisite: appropriate score on QR assessment.

**4 credits effective beginning Fall 2007. Prior to Fall 2007, course carries 2 credits.*

MATH 105: QUANTITATIVE REASONING IN TODAY'S WORLD (4)

This course focuses on the application of mathematics to the students' personal and social issues. It is designed to prepare students for the mathematics they will encounter in other college classes, particularly in the social and natural sciences such as problem solving, financial management, and growth. The course provides students with critical thinking and quantitative reasoning skills needed to understand major issues in life. It develops students' ability to reason with quantitative information necessary to achieve success in a career. Open to first-year students. Prerequisite: appropriate score on placement exam.

MATH 110: MATHEMATICAL IDEAS (4)

This course provides an introduction to various mathematical concepts for liberal arts students and is recommended for prospective elementary school teachers. Topics covered include logic, sets, number theory, numeration and mathematical systems, and problem solving. Prerequisite: appropriate score on math placement test. Not open to students who have received credit for a higher level mathematics course, except by permission. Open to first-year students.

MATH 121, 122: BASIC PRECALCULUS MATHEMATICS (2, 2)

This yearlong course is a two-term review of algebra and analytic geometry with a self-contained treatment of analytic trigonometry. This course is more basic and is paced more slowly than MATH 140. Credit will be given for either MATH 121–122 or MATH 140, but not for both. Open to first-year students. Prerequisite: appropriate score on math placement test. Students must complete both MATH 121 and MATH 122 to receive any credit.

MATH 130: MATHEMATICAL MODELING IN TODAY'S WORLD (4)

This course is a gentle introduction to mathematics in today's world. Emphasis is on the application of algebra, geometry, and mathematical models to many exciting real world problems in art, music, business, economics, statistics, and biology and other sciences. Recommended for prospective teachers and non-mathematicians.

MATH 130: MATHEMATICAL MODELING WITH PRECALCULUS I (4)

MATH 130: MATHEMATICAL MODELING WITH PRECALCULUS (4)

Emphasis is on the application of algebra, precalculus, and mathematical models to many exciting real world problems in art, music, business, economics, statistics, and biology and other sciences. Recommended for prospective teachers and nonmathematicians. Prerequisite: appropriate score on placement exam.

MATH 140: PRECALCULUS WITH MODERN APPLICATIONS (4)

Review of algebra and analytic geometry with a self-contained treatment of analytic trigonometry. Emphasis is on application of concepts to real world problems. Provides a minimal preparation for the calculus sequence. Open to first-year students. Prerequisite: appropriate score on math placement exam.

MATH 140: MATHEMATICAL MODELING WITH PRECALCULUS II (4)**MATH 140: PRECALCULUS (4)**

An exciting study of precalculus involving the application of functions and mathematical models to real-world problems in the natural sciences as well as art, music, business, economics, and the social sciences. Provides a minimal preparation for the calculus sequence. Recommended for prospective teachers. Open to first-year students. Prerequisite: appropriate score on placement exam.

MATH 152: INTUITIVE CALCULUS (4)

Ideas and techniques of the one-variable calculus needed to solve problems in a variety of disciplines. Concepts are presented from a geometric or intuitive point of view. Open to first-year students. Prerequisites: q and MATH 140 or an appropriate score on math placement test.

MATH 197F: FIRST-YEAR SEMINAR – EXPLORING NEW WORLDS: HYPERBOLIC GEOMETRY AND THE CROCHET CORAL REEF PROJECT (4)

This seminar will focus on how to adapt to and thrive in new settings. High school geometry accepts the parallel postulate as a truth. By rejecting this postulate, we will explore topics in hyperbolic geometry. This seminar will connect mathematics, a community crochet project and leadership skills. Students will learn the principles of hyperbolic geometry with Geometer's Sketchpad, practice interdisciplinary thinking, discover the importance of coral reefs and participate in the Roanoke Valley Hyperbolic Coral Reef Project. Placement to be determined over the summer.

MATH 197F: FIRST-YEAR SEMINAR – GAMES, PUZZLES AND LOGIC (4)

Games, puzzles and logic provide us with much pleasure and enjoyment. In this seminar we will analyze problem solving strategies and determine which games do and do not have winning strategies. We will consider games and puzzles of Martin Gardner (His puzzles appeared in Scientific American for 30 years.), Sam Lloyd (Game of 15) and Raymond Smullyan (Knights and Knaves), as well as present day board games (Blokus), card games (Set, Blackjack), and newspaper favorites (e.g. Sudoku, Kakuro, and Cryptograms). The goals of this seminar are to strengthen our problems solving abilities and to show how the analysis of puzzles and games can lead us to important ideas in logic, mathematics, and brain development.

MATH 197F: FIRST-YEAR SEMINAR - NUMB3RS (4)

Can mathematics be used to solve criminal mysteries? Can mathematics be used to solve other real-world mysteries and puzzles? How? In this course, students investigate real-life criminal whodunits, secret codes, games, gambling and fractals and discover how many mysteries in the world around us can best be understood through numbers. Placement to be determined during the summer.

MATH 211: SYMBOLIC LOGIC (4)

Also listed and described as PHIL 211. Prerequisite: q.

MATH 241, 242: CALCULUS I, II (6, 4)

The calculus of real functions of one real variable with emphasis on application of concepts to real world problems. Calculus I: functions, limits, continuity, the derivative and applications of the derivative. Calculus II: anti-derivatives, integrals, applications of the integral, improper integrals, sequences, and series. Open to first-year students. Prerequisites: for MATH 241: MATH 140, or MATH 121 and MATH 122, or an appropriate score on the math placement test; for MATH 242: MATH 241. MATH 241 meets daily.

MATH 246: LABORATORIES IN MATHEMATICAL EXPERIMENTATION (2)

A course in mathematical discovery. Students "do" mathematics by designing mathematical experiments, obtaining mathematical results, analyzing data and making mathematical conjectures. Topics include fractals, cryptology, function iteration and chaos, strategy of games, and graph theory. Prerequisite: MATH 241.

MATH 250: SPECIAL TOPIC - HISTORY OF MATHEMATICS (4)

The focus of this course is the history of mathematics in the ancient world. Topics include Egyptian and Babylonian (3000 BCE to 260 CE), Greek (600 BCE to 450 CE), Chinese (1000 BCE to 1300 CE), Hindu (200 BCE to 1200 CE) and Arabian (650 CE to 1200 CE) mathematics. Students will learn the principles of mathematical thinking as well as the mathematical techniques used during the time of these civilizations. Class discussions will highlight the approaches that continue to be an important part of modern mathematics as well as those that have been replaced by more recent discoveries. Daily reading and homework and three papers/presentations will be required.

MATH 250: SPECIAL TOPIC – MODELING THE ENVIRONMENT (4)

This course will use mathematical models to describe, understand and propose solutions for a variety of environmental topics encountered in the study of system dynamics. Specific examples include ground water, water flow, air quality, animal populations and hazardous materials management. We will investigate patterns of dynamic change (e.g. exponential growth, exponential decay, exponential approach, s-shaped growth, overshoot and oscillations) using hand drawn models, computer simulations, graphing programs and spreadsheets. Student interest will determine the topic of a final group project. Open to first year students. Prerequisite: q.

MATH 254: DIFFERENTIAL EQUATIONS (4)

Fundamental principles and methods of solutions of ordinary differential equations, including an introduction to the Laplace transform. Prerequisite: MATH 242 or permission.

MATH 255: METHODS OF MATRICES AND LINEAR ALGEBRA (4)

Properties of matrices; methods of finding an inverse; matrix equations and solutions; characteristic roots, important matrix forms; applications in social and physical sciences. Prerequisites: q and one college mathematics course above MATH 140 and permission.

MATH 284: DISCRETE MATHEMATICS (4)

This course is designed to help students develop the ability to think abstractly. Topics include quantifiers, set theory, counting principles, and recursion. Students learn and apply several valid forms of argument (induction, direct and indirect). The emphasis of the course is on applications of these mathematical concepts. Prerequisite: MATH 255. Students who complete both MATH 284 and MATH 310 will receive six credits total, not eight, because both classes cover the same material in the first part of the term.

MATH 290: INDEPENDENT STUDY (2 or 4)

Independent study conducted below the advanced level. Application must be made with faculty prior to registration.

MATH 297: TEACHING MATHEMATICS IN THE ELEMENTARY AND MIDDLE SCHOOLS (4)

Concepts of mathematics taught in the elementary and middle schools and some techniques for teaching these concepts. Attention will be given to problems that students have in learning and understanding mathematics.

MATH 298: TEACHING MATHEMATICS IN SECONDARY SCHOOLS (2)

Pedagogical content knowledge, curricula development, and the NCTM standards of learning, classroom organization, methodologies, monitoring student progress, assessment and evaluation, resources and technology, professional growth, and approaches to teaching algebra, geometry, trigonometry, and analysis. Prerequisite: MATH 241.

MATH 306: ELEMENTARY THEORY OF NUMBERS (4)

A study of integers and their properties; unique factorization; linear Diophantine equations; congruence; Fermat's and Wilson's theorems; divisors; perfect numbers; Euler's theorem and function; representation in various bases; and, if time permits, quadratic reciprocity. This course is strongly recommended for secondary school teachers. Prerequisite: MATH 242.

MATH 310: A TRANSITION TO ADVANCED MATHEMATICS (4)

An introduction to the standard methods of mathematical proof and their validity. Methods of proof are examined in detail and examples of each method are analyzed carefully. The emphasis is on enhancing students' ability to write and understand mathematical proofs. Prerequisite: MATH 241 or permission. Students who complete both MATH 310 and MATH 284 will receive six credits total, not eight, because both classes cover the same material in the first part of the term.

MATH 316: SEVERAL-VARIABLE CALCULUS (4)

The calculus of functions of several real variables: vector spaces; differentiation of vector functions; partial derivatives; maxima and minima; and multiple integrals. Prerequisites: MATH 242 and MATH 255 or permission.

MATH 350: SPECIAL TOPIC – A FIRST COURSE IN REAL ANALYSIS (2)

This course provides an introduction to mathematical analysis. Students will be reading mathematics and writing mathematical proofs with a focus on many of the definitions and theoretical results from single variable calculus. These results include the definition of a limit, limit properties, continuity, the derivative, differentiation results, the Mean Value Theorem, the integral, the Fundamental Theorem of Calculus and Infinite Series. Prerequisites: MATH 241, MATH 242, and MATH 310.

MATH 350: SPECIAL TOPIC - A STUDY IN ANALYSIS: FRACTALS AND CHAOS (2)

This course is an exciting mathematical study of convergence and limits. Students actively investigate concepts using numerical techniques followed by precise and careful analysis. Topics include fractals, Newton's method, basins of attraction, Julia sets, Mandelbrot sets, linear and nonlinear function iteration and chaos. Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC – ADVANCED CALCULUS (2)

This course provides an introduction to rigorous mathematical analysis. Students will be reading mathematics and writing mathematical proofs with a focus on many of the definitions and theoretical results from single variable calculus. These results include functions, the definition of a limit, limit laws, continuity, the derivative, differentiation results, the Mean Value Theorem, the integral, and the Fundamental Theorem of Calculus. Prerequisites: MATH 241, MATH 242, and MATH 310.

MATH 350: SPECIAL TOPIC – ALGEBRAIC CODING THEORY (2)

This course is an introduction to algebraic coding theory using finite fields and number theory. Codes studied include binary, hexadecimal, ASCII, Morse, Braille, Hollerith, and the error-correcting Hamming, BCH, Reed-Solomon, and two-dimensional bar codes. Prerequisite: MATH 246.

MATH 350: SPECIAL TOPIC - ALGEBRAIC GROUPS (2)

This course offers a contemporary approach to abstract algebra. The focus is on applications of group theory and the use of concrete examples and computer software to introduce and explain the abstract concepts. Applications come from music, chemistry, computer science, art, and physics. Topics covered include groups, subgroups, normal subgroups, cyclic and permutation groups, group isomorphisms and homomorphisms. Prerequisite: MATH 242; pre- or co-requisite: MATH 310 or permission.

MATH 350: SPECIAL TOPIC - ALGEBRAIC RINGS (2)

This course offers a contemporary approach to abstract algebra. The focus is on applications of ring theory and the use of concrete examples. Prerequisite: MATH 242; pre- or corequisite: MATH 310.

MATH 350: SPECIAL TOPIC – ALGEBRAIC STRUCTURES (2)

This course gives an introduction to abstract algebra. The focus is on group theory and its applications. Topics will include groups, subgroups, normal subgroups, cyclic and permutation groups, group isomorphisms and homomorphisms, as time permits. Investigating fields and rings will be considered via course projects and presentations. Prerequisite: MATH 242. Pre/corequisite: MATH 310.

MATH 350: SPECIAL TOPIC – AN INTRODUCTION TO REAL ANALYSIS (2)

This course provides an introduction mathematical analysis. Students will be reading mathematics and writing mathematical proofs with a focus on many of the definitions and theoretical results from single variable calculus. These results include the definition of a limit, limit properties, continuity, the derivative, differentiation results, the Mean Value Theorem, the integral, the Fundamental Theorem of Calculus and Infinite Series. Prerequisites: MATH 241, MATH 242, and MATH 310.

MATH 350: SPECIAL TOPIC - ANALYSIS (2)

An exciting mathematical study of convergence and limits. Students actively investigate concepts using numerical techniques followed by precise and careful analysis. Topics include fractals, linear and nonlinear function iteration, basins of attraction, chaos, complex numbers, and Newton's method. Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC - ANALYSIS AND STRATEGY OF GAMES (2)

This course is an exciting introduction to the mathematical study of conflict and cooperation known as game theory. Games arise in many different disciplines whenever two or more entities (e.g., populations, political parties, companies) confront situations where the outcome for each depends on the individual behavior of all. Is there a way to mathematically determine the "winning" strategies in these situations? Students take an active role in answering this question by first playing the matrix games and coalition games and then by working mathematically to determine the optimal strategies. Topics covered include two-person zero-sum games, two-person non-zero-sum games and N-person games with applications to biology, social psychology, politics, anthropology, warfare, business, and economics. Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC - APPLIED ALGEBRA: CODES AND CIPHERS (2)

An introduction to algebraic coding theory using finite fields and number theory. Codes studied include binary, hexadecimal, ASCII, Morse, Braille, Hollerith, and the error-correcting Hamming, BCH, Reed-Solomon, and two-dimensional bar codes. Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC - CRYPTOLOGY (2)

Cryptology consists of two disciplines. Cryptology is the art of writing secret codes and cryptanalysis is the art of revealing secret codes. Students explore the mathematical methods and theory for enciphering messages and the mathematical challenges involved in deciphering messages. Topics include monoalphabetic and polyalphabetic substitution ciphers, as well as more advanced and contemporary methods (e.g., linear, matrix, quadratic). Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC – DIFFERENTIAL EQUATIONS (2)

Fundamental principles and methods of solutions of ordinary differential equations, including an introduction to the Laplace transform. Prerequisite: MATH 242 or permission.

MATH 350: SPECIAL TOPIC - EXPLORATIONS IN NUMERICAL ANALYSIS (2)

This course is an introduction to the development and analysis of algorithms necessary for the numerical solution of mathematics problems. Topics include root-finding algorithms, interpolation, numerical differentiation, numerical integration, splines, systems of linear equations, and linear programming with emphasis on application of techniques to problems in the natural and social sciences. Prerequisite: MATH 246.

MATH 350: SPECIAL TOPIC – FIELDS AND CODES (2)

This course is an introduction to algebraic coding theory using finite fields and number theory. Codes studied include binary, hexadecimal, ASCII, Morse, Braille, Hollerith, and the error-correcting Hamming, BCH, Reed-Solomon, and two-dimensional bar codes. Prerequisite: MATH 241.

MATH 350: SPECIAL TOPIC – GEOMETRY (2)

In this course students will explore the concepts of Euclidean geometry using Geometer's Sketchpad. The goals of the course are to give students confidence in mathematical exploration, posing questions, and writing geometrical proofs. Topics from non-Euclidean geometry (e.g., Hyperbolic, Perspective and Taxi-Cab) will be considered via course projects and presentations. Prerequisite: MATH 242 or permission.

MATH 350: SPECIAL TOPIC - GRAPHS AND NETWORKS (2)

Graph theory is the study of networks, or points and lines. No other subject in mathematics begins with such simplicity, and yet, the subject is filled with important applications, sophisticated ideas, and unsolved problems. It has applications to chemistry, sociology, computer science, engineering, and sports. The course will proceed by discovery and conclude with a proof of the Four Color Theorem, one of the most famous mathematics problems to be solved this century. Prerequisite: MATH 246.

MATH 350: SPECIAL TOPIC - HISTORY OF MATHEMATICS (2)

The focus of the course is the history of mathematics from the 17th through the 19th centuries. Topics include Napier and logarithms, Descartes and the rule of signs, the beginnings of integration and differentiation, the exploitation of calculus by such mathematicians as Euler, Taylor, Maclaurin, Laplace, and Legendre, and the liberation of algebra by Hamilton, Boole, and DeMorgan. Prerequisite: MATH 242.

MATH 350: SPECIAL TOPIC - MATHEMATICAL MODELING WITH MAPLE (2)

Applications of mathematics to real-world problems in operations research, engineering, computer science, business, management, biology, physics, and chemistry. The modeling process will be introduced by identifying problems to be solved, making assumptions, collecting data, proposing models, testing the assumptions, fitting and refining the model, and analyzing the mathematical structure of the model. Models will also be given and explored "backwards" to uncover the assumptions and estimate the sensitivity of the results. Because technology is fundamental to any serious mathematical modeling, Maple will be used extensively in the course. Prerequisites: MATH 242 and MATH 255.

MATH 350: SPECIAL TOPIC – MATHEMATICS OF GAMBLING (2)

This course will introduce and develop the important, elegant, and surprisingly elementary mathematics that is needed to analyze gambling and gaming. Topics will include probability, mathematical expectation, permutations, combinations, the binomial distribution and selected ideas from game theory. We will investigate the games of roulette, backgammon, craps, and others, depending on student interest. Emphasis will be on the reasoning behind the games. Prerequisite: MATH 241.

MATH 350: SPECIAL TOPIC - NUMBER THEORY (2)

Number theory is the study of integers and their properties. Topics include unique factorization, linear Diophantine equations, congruence, Fermat's and Wilson's theorems, divisors, perfect numbers, and

representation in various bases. This course is strongly recommended for secondary school teachers.
Prerequisite: MATH 246.

MATH 350: SPECIAL TOPIC - PROBABILITY (2)

An exciting introduction to combinatorial analysis, axioms of probability, conditional probability and independence, discrete and continuous random variables, expectation and moment-generating functions.
Prerequisite: MATH 242 or permission.

MATH 350: SPECIAL TOPIC - REAL ANALYSIS (2)

A careful and precise study of the definitions of convergence, limits, and continuity. Students explore numerical examples and use these examples to develop abstract proofs. Prerequisites: MATH 242 and MATH 310.

MATH 350: SPECIAL TOPIC - STRATEGY AND ANALYSIS OF GAMES & GAMBLING (2)

This course is an introduction to the mathematical study of conflict and cooperation known as game theory. Games arise in many different disciplines whenever two or more entities (e.g. species, political parties, corporations, gamblers) confront situations where the outcome for each depends on the individual behavior of all. Students will mathematically determine “winning” strategies through active investigation and discovery. Topics covered include two person zero-sum and nonzero-sum games and n-person games with applications in anthropology, warfare, politics, business, economics, and gambling. Prerequisite: MATH 246 or permission.

MATH 350: SPECIAL TOPIC - TEACHING GEOMETRY (2)

In this course students explore the essential concepts of Euclidean geometry using Geometer’s Sketchpad. The primary goal is to give prospective teachers confidence in guiding student explorations and questions. Topics from non- Euclidean geometry (e.g., Hyperbolic, Perspective, or Taxi-Cab) will be considered via course projects. Prerequisite: MATH 242.

MATH 350: SPECIAL TOPIC - TOPICS IN GEOMETRY (2)

This course begins with the geometry of Euclid and his “Elements.” Additional topics include analytic geometry and non-Euclidean geometries. Prerequisite: MATH 241.

MATH 350: SPECIAL TOPIC - TOPICS IN GROUP THEORY (2)

This course offers a contemporary and applied approach to abstract algebra. Topics will include groups, subgroups, normal subgroups, cyclic and permutation groups, group isomorphisms and homomorphisms, as time permits. The course will offer creative approaches, methods, and activities for solving classical problems in group theory. Prerequisites: MATH 310, or MATH 246 and permission.

MATH 350: SPECIAL TOPIC - TOPICS IN KNOT THEORY (2)

A mathematical knot is a closed curve in three dimensions. Techniques in knot theory explain how to determine the invariants of a given knot, which will enable us to conclude whether two knots are equivalent. In addition to learning knot classification techniques and notation, we will consider applications of knot theory to chemistry, biology, physics and cryptology. Prerequisite: MATH 242 or permission.

MATH 350: SPECIAL TOPIC – TOPOLOGY (2)

This course is an introduction to point-set topology. Students will study basic set theory, cardinality, functions, topology definitions, continuity and some theoretical results such as homeomorphism between functions. Emphasis will be placed on rigorous mathematical reasoning and proof methods. Prerequisite: MATH 310

MATH 390: INDEPENDENT STUDY (2 or 4)

Independent study conducted at the advanced level. Application must be made with faculty prior to registration.

MATH 397: TEACHING MATHEMATICS IN THE ELEMENTARY AND MIDDLE SCHOOLS (4)

Concepts of mathematics taught in the elementary and middle schools and some techniques for teaching these concepts. Attention will be given to problems that students have in learning and understanding mathematics. Open to junior and seniors with permission.

MATH 398: TEACHING MATHEMATICS IN SECONDARY SCHOOLS (2)

Pedagogical content knowledge, curricula development, and the NCTM standards of learning, classroom organization, methodologies, monitoring student progress, assessment and evaluation, resources and technology, professional growth, and approaches to teaching algebra, geometry, trigonometry, and analysis. Open to juniors and seniors with permission.

MATH 399: INTERNSHIPS (4)

Application must be made with faculty prior to registration.

MATH 471: MATHEMATICS SEMINAR (2)

Selected and current topics in the mathematical sciences. Emphasis is on written and oral communication of mathematical ideas. Senior mathematics majors complete a mathematics portfolio based on select assignments from previous mathematics and statistics courses. Other seniors and junior majors may enroll with permission.

MATH 471: MATHEMATICS SEMINAR - TOPICS IN GROUP THEORY (2)

This course offers a contemporary approach to abstract algebra. The focus will be on applications of group theory and the use of concrete examples and computer software to introduce and explain the abstract concepts. Applications will come from music, chemistry, computer science, art, and physics. Topics covered will include groups, subgroups, normal subgroups, cyclic and permutation groups, group isomorphisms, and homomorphisms. Prerequisite: emphasis is on written and oral communication of mathematical ideas. Senior mathematics majors complete a mathematics portfolio based on select assignments from previous mathematics and statistics courses. Other seniors and junior majors may enroll with permission.

MATH 472: MATHEMATICS SEMINAR (2)

In this course students have an opportunity to explore advanced and/or new mathematical topics. Students may suggest projects to departmental faculty for their approval and guidance. Students will present completed projects at the end of the semester.

MATH 480: SENIOR THESIS (2)

An extensive research project to be carried out over one semester and Short Term. Open to qualified senior mathematics majors. Prerequisite: MATH 471.

MATH 490: SENIOR HONORS (2, 2)

Open to majors with permission. Required both regular terms and Short Term. Interested majors should consult with the chair of the department no later than the end of the second term of their junior year. Application must be made with faculty prior to registration.