

## Course Description

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### MATH 105, BEGINNING ALGEBRA

Basic concepts and techniques of algebra including a review of real numbers, fractions, equations, inequalities, problem solving, graphs, functions, solving systems of linear equations, exponents, polynomials and factoring polynomials. College credit given only to students with deficiencies in the mathematics admission requirement. Not open to students who have credit for any higher-numbered mathematics course. fall only

### MATH 106, INTERMEDIATE ALGEBRA

Basic concepts and techniques of algebra, rational functions and expressions, problem solving, radicals, rational exponents, complex numbers, quadratic equations and functions, exponential and logarithmic functions, sequences and series. College credit given only to students with deficiencies in the mathematics admission requirement. Not open to students who have credit for any higher-numbered mathematics course. every sem.

### MATH 107, BASIC INTEGRATED MATHEMATICS

Development of basic algebraic skills with some geometry. The course is designed as a bridge between high school mathematics and elementary statistics. It is not adequate preparation for calculus. Prerequisites: two years of high school math. Not open for credit to students who have credit for Math 147. every sem.

### MATH 108, ALGEBRA AND TRIGONOMETRY

Topics essential for the study of calculus, including elements of trigonometry, complex numbers, logarithms and basic algebra. Skill development in algebraic and trigonometric manipulations. Not open for credit to students who have credit for Math 221. every sem.

### MATH 130, MATHEMATICS IN ACTION

Emphasizes the real-world significance of mathematics and applications of several areas of mathematics. Topics covered include design of street networks, planning and scheduling, weighted voting systems, fair division and apportionment, measuring populations and the universe, symmetries, fractals and statistics. Provides students with an experience in quantitative reasoning and data analysis through mathematical modeling of some real-life problems including a hands-on approach. Further emphasis is on illustrating the importance, relevance and currency of mathematics in the modern world. every sem.

### MATH 147, ELEMENTARY STATISTICS

Classification of data, frequency distributions, probability and the normal curve, elementary sampling theory. Not open to students who have credit for any other course in statistics. Prerequisite: MATH 107. every sem.

## MATH 148, ELEMENTARY STATISTICS FOR BIOLOGISTS

Elementary Statistics for Biologists. Data analysis, probability, normal curve, regression, confidence intervals, hypothesis testing. This course will emphasize applications to biology. Not open to students who have credit for any other course in statistics. Prerequisite: MATH 107. every sem.

## MATH 220, CALCULUS FOR BUSINESS AND MANAGEMENT

Elements of calculus; emphasis on maximum and minimum problems. Primarily for School of Management students, who may satisfy their mathematics requirement with either MATH 220 or 221, and for economics majors in the BS specialization in financial economics. Not equivalent to MATH 221 as prerequisite for MATH 222. Prerequisite: MATH 108 or equivalent. every sem.

## MATH 221, CALCULUS I

Differentiation and integration of elementary functions. Prerequisite: MATH 108 or equivalent. every sem.

## MATH 222, CALCULUS II

Techniques and application of integration. Sequences and series. Prerequisite: MATH 221. every sem.

## MATH 304, LINEAR ALGEBRA

Vector spaces, linear transformations, determinants, characteristic values. Prerequisite: MATH 221. every sem.

## MATH 314, DISCRETE MATHEMATICS

Logic, sets, relations, functions. Induction, recursion, counting methods. Graphs, trees. Some abstract algebra. Prerequisite: MATH 221. every sem.

## MATH 323, CALCULUS III

Calculus of functions of several variables. Prerequisite: MATH 222. every sem.

## MATH 327, PROBABILITY WITH STATISTICAL METHODS

Development of probabilistic concepts in discrete and absolutely continuous cases. Classical combinatorial methods, independence, random variables, distributions, moments, transformations, conditioning, confidence intervals, estimation. Open to Watson School students only. Does not serve as a prerequisite for MATH 448 or for any actuarial science courses. Prerequisite: MATH 222 or consent of department. every sem.

## MATH 330, NUMBER SYSTEMS

Careful discussion of the real numbers, the rational numbers and the integers, including a thorough study of induction and recursion. Countable and uncountable sets. The methodology of mathematics: basic logic, the use of quantifiers, equivalence relations, sets and functions. Methods of proof in mathematics. Training in how to discover and write proofs. Prerequisite: MATH 222. every sem.

## MATH 346, INTRODUCTION TO FINANCIAL MATHEMATICS

Interest theory, annuities, amortization, bonds, portfolio insurance, Derivative markets. The material will focus on the actuarial mathematics requirements for the Exam FM. Prerequisite: MATH 222. every sem.

## MATH 356, MATHEMATICAL MODELING

Mathematical structures that allow people to describe and discuss naturally occurring phenomena. Possible topics include functions as models, recurrence relations, networks and graph theory, linear programming, discrete probability models, Markov chains, Monte Carlo simulations, random walks, queuing theory, recursive game theory. For each topic, we will discuss the mathematics rigorously and then analyze some real-world applications. Prerequisites: MATH 304 and either MATH 314 or MATH 330. spring only

## MATH 371, ORDINARY DIFFERENTIAL EQUATIONS

Ordinary differential equations. Emphasis on applications to problems in physics, chemistry, biology, economics, etc. Prerequisite: MATH 222. fall only

## MATH 372, DYNAMICAL SYSTEMS

Introduction to ordinary differential equations using linear algebra and geometry. The emphasis is on understanding long-term features of the solutions, rather than on solving the equations analytically. Topics include mathematical modeling; linear systems of differential equations; non-linear systems; stability of equilibria and periodic orbits; numeric methods; chaotic systems. Prerequisites: MATH 222 and MATH 304. every sem.

## MATH 375, COMPLEX VARIABLES

Analytic functions. Cauchy's integral theorem, power series. Prerequisite: MATH 323. spring only

## MATH 381, GRAPH THEORY

Directed and undirected graphs, trees, connectivity, Eulerian and Hamiltonian graphs, planar graphs, coloring of graphs, graph parameters, optimization and graph algorithms. Prerequisites: MATH 304, and either MATH 314 or 330, or consent of department. spring only

## MATH 386, COMBINATORICS

Topics from among counting techniques, generating function and recurrence relations, pigeonhole principle, Ramsey's Theorem, Latin squares, combinatorial designs. Prerequisites: MATH 304 and either MATH 314 or 330, or consent of department. fall only

## MATH 391, PRACTICUM IN COLLEGE TEACHING

Independent study through teaching in particular mathematics course. Various assignments closely directed by instructor in course, including development of syllabi and other course materials; construction and reading of examinations; lecturing and/or discussion leadership; laboratory supervision; academic counseling of student. May be repeated for total of no more than eight credits. Credits may not be earned in conjunction with course in which student is currently enrolled. Does not satisfy major or Harpur College Distribution requirements. Prerequisite: consent of instructor. Pass/Fail only. var. cr.

## MATH 401, MODERN ALGEBRA I

Groups, rings, integral domains, fields. Prerequisites: MATH 304 and 330, or consent of department. fall only

## MATH 402, MODERN ALGEBRA II

Further study of topics in MATH 401. Vector spaces, modules, lattices, Galois theory. Prerequisite: MATH 401. spring only

## MATH 404, ADVANCED LINEAR ALGEBRA

Modules, normal forms of linear transformations, quadratic forms. Prerequisites: MATH 304 and 330, or consent of department. spring only

## MATH 407, INTRODUCTION TO THE THEORY OF NUMBERS

Classical number theory. Divisibility, prime numbers, quadratic reciprocity, Diophantine equations. Prerequisite: MATH 330 or consent of department. offered as needed

## MATH 447, INTRODUCTION TO PROBABILITY AND STATISTICS I

Basic concepts of probability, univariate and multivariate distributions, distribution theory, central limit theorem. Prerequisite: MATH 323 or consent of department. every sem.

## MATH 448, INTRODUCTION TO PROBABILITY AND STATISTICS II

Estimation, confidence intervals and hypothesis testing. Introduction to linear models, categorical data and

nonparametric statistics. Prerequisite: MATH 447. every sem.

### **MATH 449, PROBLEM SOLVING IN ACTUARIAL SCIENCE**

Prerequisite: Math 447 or consent of department. spring only

### **MATH 450, ACTUARIAL MATHEMATICS I**

Markov chains, Poisson processes, survival models, life tables, life insurance, life annuities. The material will focus on the actuarial mathematics requirements for the Exam MLC. Prerequisites: MATH 330, MATH 346 and MATH 447. fall only

### **MATH 452, ACTUARIAL MATHEMATICS II**

Benefit premiums, benefit reserves, multiple life functions, multiple decrement functions. The material will focus on the actuarial mathematics requirements for the Exam MLC. Prerequisite: MATH 222, MATH 304 and MATH 450. spring only

### **MATH 454, FINANCIAL MATHEMATICS**

Interest rate models, principle of no arbitrage, fundamental theorem of asset pricing, evaluation of derivatives, put-call parity, European put and call options, binomial models, Black-Scholes option-pricing model, American options, option Greeks, exotic options, lognormal distribution, diffusion process, Ito's lemma, simulation and delta-hedging. The material will focus on the requirements for the Exam MFE. Prerequisites/Co-requisites: MATH 346, MATH 447 or equivalent. every spring

### **MATH 461, TOPOLOGY**

Study of topological spaces. Metric spaces, separation properties, connectivity, compactness. Prerequisites: MATH 304, 323 and 330, or consent of department. fall only

### **MATH 465, FOUNDATIONS OF GEOMETRY**

Postulational treatment of geometric systems, including projective, affine and non-Euclidean geometries. Prerequisites: MATH 304 and 330, or consent of department. offered as needed

### **MATH 471, PARTIAL DIFFERENTIAL EQUATIONS**

Vector calculus, Fourier series, partial differential equations, with emphasis on applications. Prerequisite: MATH 371 or 372. spring only

## MATH 472, PDE AND MATHEMATICAL ANALYSIS

Partial differential equations of mathematics, including first order equations, second order equations of potential theory, wave propagation, and heat flow, and higher order equations. We solve these equations by means of classical Fourier analysis, functional analysis, generalized functions and variational principles. Topics vary year by year. Prerequisites: MATH 330 and either MATH 371 or MATH 372 or equivalent. every spring

## MATH 478, REAL ANALYSIS I

Geometry and topology of  $\mathbb{R}^n$ , functions and limits, calculus of functions on  $\mathbb{R}^n$  and higher dimensional spaces. Prerequisites: MATH 304, 323 and 330, or consent of department. fall only

## MATH 479, REAL ANALYSIS II

Sequences and series of functions, more advanced study of differentiation and integration. Prerequisite: MATH 478. spring only

## MATH 480, SEMINAR IN ALGEBRA

spring only, var. cr.

## MATH 488, TOPICS IN HIGHER MATHEMATICS

Some topics in higher mathematics not normally part of regular curriculum. Prerequisites: consent of department. May be repeated for credit. offered as needed

## MATH 489, PROBLEM SOLVING

Problem solving is a part of mathematics organized around methods rather than theorems. For this reason it is somewhat amorphous, and difficult to study, but the ideas are applicable to almost any part of mathematics. For purposes of this class, there is a distinction between problems and exercises. An exercise is a question that tests mastery of a narrowly focused technique. In a problem, by contrast, the technique to be used is not immediately apparent. Problems are sometimes open-ended, poorly-defined, or even unsolvable. The objective of the course is to introduce students to a variety of mathematical knowledge and techniques useful for mathematical problem solving and not always covered in other courses. This course will be run partly in a seminar format; students will be expected to regularly present their own work to the class. Students will be expected to participate in the William Lowell Putnam Mathematical Competition (which is held on the first Saturday in December). Prerequisites: consent of department. fall only

## MATH 497, INDEPENDENT WORK

Individual study under direct supervision of faculty member. Prerequisites: consent of department. May be repeated for credit with maximum of eight credit hours of MATH 497 allowed toward major requirements. var. cr.

## MATH 498, HONORS STUDY IN MATHEMATICS

Independent studies/research open only to students who have been accepted in the mathematics honors program. May be repeated for credit, with maximum of four credit hours of MATH 498 allowed toward major requirements. Prerequisite: consent of department.

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Last update: **2015/02/26 21:48**