MATHEMATICS

COURSE 18

CONTACT

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WEBSITE

https://math.mit.edu/academics/undergrad/index.php

DESCRIPTION

Mathematicians use mathematical theory, computational techniques, algorithms, and the latest computer technology to solve economic, scientific, engineering, physics, and business problems. Math majors study quantities, forms, and symbolic logic in such subjects as algebra, geometry, calculus, logic, topology, and number theory. Theoretical mathematicians advance mathematical knowledge by developing new principles and recognizing previously unknown relationships between existing principles of mathematics. Applied mathematicians use theories and techniques to formulate and solve practical problems in business, government, engineering, and in the physical, life, and social sciences.

INSIDE COURSE 18

18	Mathematics (general, pure and applied tracks)	Undergraduates: 270
18-C	Mathematics with Computer Science	Undergraduates: 107

INTRODUCTORY CLASSES

18.03 **Differential Equations**
Study of differential equations, including modeling physical systems. Solution of first-order ODEs by analytical, graphical, and numerical methods. Linear ODEs with constant coefficients. Complex numbers and exponentials. Inhomogeneous equations: polynomial, sinusoidal, and exponential inputs. Oscillations, damping, resonance. Fourier series. Matrices, eigenvalues, eigenvectors, diagonalization. First order linear systems: normal modes, matrix exponentials, variation of parameters. Heat equation, wave equation. Nonlinear autonomous systems: critical point analysis, phase plane diagrams.

18.06 **Linear Algebra**
Basic subject on matrix theory and linear algebra, emphasizing topics useful in other disciplines, including systems of equations, vector spaces, determinants, eigenvalues, singular value decomposition, and positive definite matrices. Applications to least-squares approximations, stability of differential equations, networks, Fourier transforms, and Markov processes.

18.100 **Real Analysis**
Covers fundamentals of mathematical analysis: convergence of sequences and series, continuity, differentiability, Riemann integral, sequences and series of functions, uniformity, interchange of limit operations. Shows the utility of abstract concepts and teaches understanding and construction of proofs. Proofs and definitions are less abstract than in 18.100B. Gives applications where possible. Concerned primarily with the real line.

18.200 **Principles of Discrete Applied Mathematics**
Study of illustrative topics in discrete applied mathematics, including probability theory, information theory, coding theory, secret codes, generating functions, and linear programming. Instruction and practice in written communication provided.

18.700 **Linear Algebra**
Vector spaces, systems of linear equations, bases, linear independence, matrices, determinants, eigenvalues, inner products, quadratic forms, and canonical forms of matrices. More emphasis on theory and proofs than in 18.06.

18.701 **Algebra I**
18.701-18.702 is more extensive and theoretical than the 18.700-18.703 sequence. Experience with proofs necessary. 18.701 focuses on group theory, geometry, and linear algebra.

18.600 **Probability and Random Variables**
Probability spaces, random variables, distribution functions. Binomial, geometric, hypergeometric, Poisson distributions. Uniform, exponential, normal, gamma and beta distributions. Conditional probability, Bayes theorem, joint distributions. Chebyshev inequality, law of large numbers, and central limit theorem.

COURSE 18-UROPs

Research is typically completed under supervision of specific professors rather than different labs. Please visit math.mit.edu/research for more information.

GET INVOLVED WITH COURSE 18

Undergraduate Math Association (UMA)

Undergraduate Society for Women in Math (USWIM)

Council for Math Majors (CoMM)

SKILLS

Analytical and quantitative reasoning

Data analysis

Communication and technical writing

Independent thinking

POSSIBLE FUTURE POSITIONS

- **Actuary:** Deal with the financial impact of risk and uncertainty. Actuaries mathematically evaluate the likelihood of events and quantify the contingent outcomes in order to minimize losses.
- **Mathematician:** Use mathematical theory, computational techniques, algorithms, and the latest computer technology to solve economic, scientific, engineering, and

business problems.

- **Statistical consultant:** Collaborate with companies and organizations to analyze research and data.

CAREER INDUSTRY EXAMPLES

Accounting	Economics	Insurance
Budget analytics	Education	Investment analytics
Cryptography	Finance	Marketing

SAMPLE EMPLOYERS

Arena Investors	Fidelity Investments	McKinsey & Company
Bracebridge Capital	Goldman Sachs	Morgan Stanley
Capital One	IMC Trading	Rhapsody Venture Partners