Graduate-level courses are marked with a *

Both graduate-level courses not taken at Bowdoin were instructor-paced and had proctored final exams

Official Course Title	Course #	Topics covered	Textbook(s)	Grade	Institution
Honors Project Semester II*	MATH 4051	Research in number theory	Multiple reference texts (same as entry directly below), but mostly research papers	In progress	Bowdoin College
Honors Project Semester I*	MATH 4051	*L*-functions (Hecke and Dirichlet), Jacobi and theta functions, random matrix theory, *n*-level densities, Ratios Conjecture, selected topics in analytic number theory and Fourier analysis	No official text, multiple reference texts: *Classical Introduction to Modern Number Theory,* Ireland and Rosen *Algebraic Number Theory,* Jürgen Neukirch *Multiplicative Number Theory,* Davenport *An Invitation to Modern Number Theory,* Miller and Takloo-Bighash	A	Bowdoin College
Official: Advanced Collaborative Study* (*Actually*: Algebraic Topology)	MATH 4029	categories and functors, homotopy, CW complexes, fundamental group, Van Kampen, covering spaces, Deck transformations, graphs and free groups, homology (simplicial, singular, cellular), Mayer-Vietoris sequences	*Algebraic Topology,* Allen Hatcher (chapters 0-2)	A	Bowdoin College
Official: Advanced Collaborative Study* (*Actually*: Algebraic Number Theory)	MATH 4029	number fields and number rings, prime decomposition, Galois theory, ideal class group and unit group, distribution of ideals, Dedekind zeta function, class number formula, distribution of primes, basics of class field theory	*Number Fields,* Daniel A. Marcus	A	Bowdoin College
Complex Analysis*	NA	complex differentiation and integration, fundamental theorem of calculus, homotopy, Cauchy's theorem, Cauchy integral formula, Cauchy's inequalities, winding number, open mapping theorem, Schwarz reflection principle, singularities, Laurent series, residue theorem, argument principle, Rouche's theorem, automorphisms of unit disk, covering spaces, Picard's theorems, elliptic functions	*Complex Analysis,* Ahlfors	100% on proctored final exam	Kerala School of Mathematics link to certificate

Numerical Methods*	NA	roots of nonlinear equations, interpolation, direct and iterative methods for linear systems, eigenvalue decompositions and QR/SVD factorizations, stability and accuracy of numerical algorithms, the IEEE floating-point standard, sparse and structured matrices, Gershgorin circle theorem, Jacobi method, power methods, numerical Differentiation, Euler method, Euler modified method, Runge-Kutta methods, Milne PC method	*Numerical Linear Algebra,* Trefethen and Bau III	80% Rank 1 amongst 110 students	IIT Roorkee link to certificate
Adv. Topics in Probability and Statistics	MATH 3606	Bayesian methods: belief, probability, exchangeability, one-parameter models, Monte-Carlo approximation, normal model, posterior approximation with Gibbs sampler, hierarchical modeling, linear regression, conjugate and nonconjugate priors, Metropolis-Hastings algorithms	*First Course in Bayesian Statistical Methods,* Peter Hoff *An Introduction to Stochastic Processes with R,* Dobrow	In progress	Bowdoin College
Advanced Analysis	MATH 3603	measure theory and integration, Lebesgue measure and integral, measurable functions and random variables, convergence theorems, analysis of random processes including random walks and Brownian motion, Itô integral; applications to probability and mathematical finance	No official text, multiple reference texts: *Measure Theory,* Halmos *Real and Complex Analysis,* Rudin *Measure Theory and Probability,* Adams	A- please see SOP and/or special circumstances section for explanation of grade	Bowdoin College
Real Analysis	MATH 2603	construction of real numbers as a complete ordered field, convergence, continuity, differentiability, Riemann integrability, Mean Value Theorem and the Fundamental Theorems of Calculus	*Principles of Mathematical Analysis,* Rudin	100% on final exam, tested out of course	Bowdoin College
Official: Adv. Topics in Rings *Actually:* Algebraic Geometry	MATH 3702	affine algebraic varieties, algebraic foundations, projective varieties, classical constructions, gröbner bases, elimination theory	*Ideals, Varieties, and Algorithms,* Cox, Little and O'Shea *Invitation to Algebraic Geometry,* Karen Smith	A	Bowdoin College

Rings and Fields	MATH 2702	homomorphisms, ideals, quotient rings, integral domains, polynomial rings, field extensions, UFDs, PIDs, rings of fractions, finite fields, vector spaces over arbitrary fields, modules, Galois theory	*Contemporary Abstract Algebra,* Gallian	A	Bowdoin College
Adv. Topics in Geometry	MATH 3404	axiomatic foundations of metric geometry. transformational geometry: isometries and similarities, Klein's Erlangen program, isometry groups of Euclidean and hyperbolic spaces, alternate models of hyperbolic geometry, projective geometry	*Low-dimensional Geometry,* Francis Bonahan	A	Bowdoin College
Machine Learning	MATH 2805	mathematical theory and practice of machine learning; supervised and unsupervised learning with topics including regression, classification, clustering, dimension reduction, data visualization, denoising, norms and loss functions, neural networks, optimization, universal approximation theorems, algorithmic fairness	*The Elements of Statistical Learning,* T. Hastie, R. Tibshirani, and J. Friedman *Machine Learning: A Probabilistic Perspective,* Kevin Murphy	A	Bowdoin College
Statistics	MATH 2606	fundamentals of mathematical statistics, likelihood methods, point and interval estimation, tests of significance, hypothesis tests, binomial, Poisson, and exponential models, frequency data, analysis of normal measurements	No official text	A	Bowdoin College
Topology	MATH 3204	point-set topology (standard topics from Munkres); examinations of surfaces, knots and manifolds; fundamental group; Heegaard splittings; fixed point theorems	No official text	A	Bowdoin College

Statistics for Applications	18.6501x	parametric inference, maximum likelihood estimation, method of moments, parametric hypothesis testing, testing goodness of fit, regression, bayesian statistics, principal component analysis, generalized linear models	No official text	97%	MITx link to certificate
Probability and Random Variables	6.431x	discrete and continuous random variables, derived distributions, convolution, covariance and correlation, Markov chains, weak and strong law of large numbers, central limit theorem	*Introduction to Probability,* Bertsekas and Tsitsiklis	95%	MITx link to certificate
Adv. Topics in Group Theory (geometric group theory)	MATH 3606	selected topics in geometric theory: Cayley's theorems, groups acting on trees, Baumslag-Solitar groups, words and Dehn's word problem	No official text	B please see SOP and/or special circumstances section for explanation of grade	Bowdoin College
Group Theory	MATH 2606	homomorphisms, isomorphisms, normal subgroups, quotient groups, structure of finite abelian groups, Sylow theorems, group actions	*Contemporary Abstract Algebra,* Gallian	A	Bowdoin College
Linear Algebra	MATH 2000	vectors, linear independence and span, linear transformations, matrices and their inverses, bases, dimension and rank, determinants, eigenvalues and eigenvectors, diagonalization and change of basis, and orthogonality; applications to linear systems of equations, discrete dynamical systems, Markov chains, computer graphics, and least-squares approximation	*Linear Algebra and Its Applications,* Gilbert Strang	100% on final exam, tested out of course	Bowdoin College

Differential Equations	18.03x	solution of first-order ODE's by analytical, graphical and numerical methods; linear ODE's; undetermined coefficients and variation of Parameters; sinusoidal and exponential signals: oscillations, damping, resonance; matrix exponentials; Fourier series, periodic solutions; delta functions, convolution, Laplace transform; matrix and first-order linear systems; non-linear autonomous systems: critical point analysis and phase plane diagrams	*Elementary Differential Equations with Boundary Value Problems,* Edwards and Penney	96%	MITx link to certificates
Probability	MATH 2206	combinatorial models, probability spaces, conditional probability, discrete and continuous random variables, independence and expected values	*Probability,* Jim Pitnam	100% on final exam, tested out of course	Bowdoin College
Combinatorics and Graph Theory	MATH 2601	combinatorics, enumeration, partitions, generating functions, partially ordered sets, graph theory, matchings, colorings, Ramsey theory	No official text	Credit mandatory credit / no credit in effect because of COVID	Bowdoin College
Intro Math Reasoning	MATH 2020	logical deductive reasoning, set and function theory, modular arithmetic, proof by induction, cardinality of infinite sets	*Introduction to Mathematical Structures and Proofs,* Larry J. Gerstein	Credit mandatory credit / no credit in effect because of COVID	Bowdoin College
Multivariate Calculus	MATH 1800	vectors and curves in two and three dimensions, partial and directional derivatives, the gradient, chain rule in higher dimension, double and triple integration, polar, cylindrical, and spherical coordinates, line integration, conservative vector fields, Green's theorem, Stokes' theorem	*Multivariable Calculus,* Hughes-Hallet, Gleason, McCallum	A	Bowdoin College