MATHEMATICS (MATH)

MATH*1030 Business Mathematics Fall and Winter (LEC: 3) [0.50]
Primarily intended for business and economics students, this course is designed to introduce and reinforce the essential mathematical skills needed to understand, analyze, and solve mathematical problems related to business and economics. Topics covered include basic algebra; functions, including a review of exponential and logarithmic functions; sequences and series with financial applications; limits; continuity; and differential calculus including derivatives, higher order derivatives, and curve sketching.
Offering(s): Also offered through Distance Education format.
Prerequisite(s): 4U Advanced Functions
Restriction(s): MATH*1080, MATH*1200. Not available to students registered in the BSC program.
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*1080 Elements of Calculus I Fall and Winter (LEC: 3, LAB: 1) [0.50]
This course provides an introduction to the calculus of one variable with emphasis on mathematical modelling in the biological sciences. The topics covered include elementary functions, sequences and series, difference equations, differential calculus and integral calculus.
Offering(s): Also offered through Distance Education format.
Prerequisite(s): 1 of 4U Advanced Functions, 4U Advanced Functions and Calculus or equivalent
Restriction(s): IPS*1500, MATH*1200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*1090 Elements of Calculus II Winter Only (LEC: 3, LAB: 1) [0.50]
This course will expand on integration techniques, and introduce students to difference and differential equations, vectors, vector functions, and elements of calculus of two or more variables such as partial differentiation and multiple integration. The course will emphasize content relevant to analyzing biological systems, and methods will be illustrated by application to biological systems.
Prerequisite(s): 1 of IPS*1500, MATH*1080, MATH*1200
Restriction(s): IPS*1510, MATH*1210, MATH*2080
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*1160 Linear Algebra I Fall and Winter (LEC: 3) [0.50]
This course provides an introduction to linear algebra in Euclidean space. Topics covered include: N-dimensional vectors, dot product, matrices and matrix operations, systems of linear equations and Gaussian elimination, linear independence, subspaces, basis and dimension, matrix inverse, matrix rank and determinant, eigenvalues, eigenvectors and diagonalization, orthogonalization and projections, linear transformations. Some fundamental proofs and applications of these topics will be included.
Prerequisite(s): 4U Calculus and Vectors or 4U Advanced Functions
Restriction(s): ENGG*1500. This is a Priority Access Course. Enrolment may be restricted to particular programs or specializations. Please contact the department for more information.
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*1200 Calculus I Fall Only (LEC: 3, LAB: 1) [0.50]
This is a theoretical course intended primarily for students who expect to pursue further studies in mathematics and its applications. Topics include inequalities and absolute value; compound angle formulas for trigonometric functions; limits and continuity using rigorous definitions; the derivative and derivative formulas (including derivatives of trigonometric, exponential and logarithmic functions); Fermat's theorem; Rolle's theorem; the mean-value theorem; applications of the derivative; Riemann sums; the definite integral; the fundamental theorem of calculus; applications of the definite integral; the mean value theorem for integrals.
Prerequisite(s): 1 of 4U Calculus and Vectors, 4U Advanced Functions and Calculus or Grade 12 Calculus
Restriction(s): IPS*1500, MATH*1080
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*1210 Calculus II Winter Only (LEC: 3, LAB: 1) [0.50]
This course is a continuation of MATH*1200. It is a theoretical course intended primarily for students who need or expect to pursue further studies in mathematics, physics, chemistry, engineering and computer science. Topics include inverse functions, inverse trigonometric functions, hyperbolic functions, indeterminate forms and l'Hopital's rule, techniques of integration, parametric equations, polar coordinates, Taylor and Maclaurin series; functions of two or more variables, partial derivatives, and if time permits, an introduction to multiple integration.
Prerequisite(s): MATH*1080 or MATH*1200
Restriction(s): IPS*1510, MATH*1090, MATH*2080
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*2000 Proofs, Sets, and Numbers Fall Only (LEC: 3, LAB: 1) [0.50]
This course exposes the student to formal mathematical proof, and introduces the theory of sets and number systems. Topics include relations and functions, number systems including formal properties of the natural numbers, integers, and the real and complex numbers. Equivalence relations and partial and total orders are introduced. The geometry and topology of the real number line and Cartesian plane are introduced. Techniques of formal proof are introduced including well-ordering, mathematical induction, proof by contradiction, and proof by construction. These techniques will be applied to fundamental theorems from linear algebra.
Prerequisite(s): 1 of IPS*1500, MATH*1080, MATH*1160, MATH*1200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*2130 Numerical Methods Winter Only (LEC: 3, LAB: 1) [0.50]
This course provides a theoretical and practical introduction to numerical methods for approximating the solution(s) of linear and nonlinear problems in the applied sciences. The topics covered include: solution of a single nonlinear equation; polynomial interpolation; numerical differentiation and integration; solution of initial value and boundary value problems; and the solution of systems of linear and nonlinear algebraic equations.
Prerequisite(s): (1 of CIS*1300, CIS*1500, ENGG*1410), (1 of IPS*1510, MATH*1090, MATH*1210, MATH*2080)
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*2200 Advanced Calculus I Fall Only (LEC: 3) [0.50]
The topics covered in this course include infinite sequences and series, power series, tests for convergence, Taylor's theorem and Taylor series for functions of one variable, planes and quadratic surfaces, limits, and continuity, differentiability of functions of two or more variables, partial differentiation, directional derivatives and gradients, tangent planes, linear approximation, Taylor's theorem for functions of two variables, critical points, extreme value problems, implicit function theorem, Jacobians, multiple integrals, and change of variables.
Prerequisite(s): 1 of IPS*1510, MATH*1090, MATH*1210, MATH*2080
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*2210 Advanced Calculus II Winter Only (LEC: 3) [0.50]
This course continues the study of multiple integrals, introducing spherical and cylindrical polar coordinates. The course also covers vector and scalar fields, including the gradient, divergence, curl and directional derivative, and their physical interpretation, as well as line integrals and the theorems of Green and Stokes.
Prerequisite(s): MATH*2200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*2270 Applied Differential Equations Fall Only (LEC: 3, LAB: 1) [0.50]
This course covers the solution of differential equations that arise from problems in engineering and science. Topics include linear equations of first and higher order, systems of linear equations, Laplace transforms, series solutions of second-order equations, and an introduction to partial differential equations.
Prerequisite(s): (ENGG*1500 or MATH*1160), (1 of IPS*1510, MATH*1090, MATH*1210, MATH*2080)
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3100 Differential Equations II Winter Only (LEC: 3, LAB: 1) [0.50]
This course continues the study of differential equations. Power series solutions around regular singular points including Bessel equations are presented. First order linear systems and their general solution by matrix methods are thoroughly covered. Nonlinear systems are introduced along with the concepts of linearization, stability of equilibria, phase plane analysis, Lyapunov's method, periodic solutions and limit cycles. Two-point boundary value problems are discussed and an introduction to linear partial differential equations and their solution by separation of variables and Fourier series is given.
Prerequisite(s): MATH*2270, (ENGG*1500 or MATH*1160)
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3130 Abstract Algebra Fall Only (LEC: 3) [0.50]
This course is an introduction to abstract algebra, covering both group theory and ring theory. Specific topics covered include an introduction to group theory, permutations, symmetric and dihedral groups, subgroups, normal subgroups and factor groups. Group theory continues through the fundamental homomorphism theorem. Ring theory material covered includes an introduction to ring theory, subrings, ideals, quotient rings, polynomial rings, and the fundamental ring homomorphism theorem.
Offering(s): Offered in even-numbered years.
Prerequisite(s): MATH*1160, MATH*2000
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3160 Linear Algebra II Fall Only (LEC: 3) [0.50]
The topics in this course include complex vector spaces, direct sum decompositions of vector spaces, the Cayley-Hamilton theorem, the spectral theorem for normal operators and the Jordan canonical form.
Prerequisite(s): MATH*1160, 1.00 credits in MATH or STAT at the 2000 level or above
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3200 Real Analysis Fall Only (LEC: 3) [0.50]
This course provides a basic foundation for real analysis. The rigorous treatment of the subject in terms of theory and examples gives students the flavour of mathematical reasoning and intuition for other advanced topics in mathematics. Topics covered include the real number line and the supremum property; metric spaces; continuity and uniform continuity; completeness and compactness; the Banach fixed-point theorem and its applications to ODEs; uniform convergence and the rigorous treatment of the Riemann integral.
Prerequisite(s): MATH*2000, (MATH*1160 or MATH*2160)
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3240 Operations Research Fall Only (LEC: 3) [0.50]
This is a course in mathematical modelling which has applications to engineering, economics, business and logistics. Topics covered include linear programming and the simplex method, network models and the shortest path, maximum flow and minimal spanning tree problems as well as a selection of the following: non-linear programming, constrained optimization, deterministic and probabilistic dynamic programming, game theory and simulation.
Offering(s): Offered in odd-numbered years.
Prerequisite(s): MATH*1160, 0.50 credits in statistics
Co-requisite(s): MATH*2200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3260 Complex Analysis Winter Only (LEC: 3) [0.50]
This course extends calculus to cover functions of a complex variable; it introduces complex variable techniques which are very useful for mathematics, the physical sciences and engineering. Topics include complex differentiation, planar mappings, analytic and harmonic functions, contour integration, Taylor and Laurent series, the residue calculus and its application to the computation of trigonometric and improper integrals, conformal mapping and the Dirichlet problem.
Prerequisite(s): MATH*2200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*3510 Biomathematics Winter Only (LEC: 3) [0.50]
This course will convey the fundamentals of applying mathematical modelling techniques to understanding and predicting the dynamics of biological systems. Students will learn the development, analysis, and interpretation of biomathematical models based on discrete-time and continuous-time models. Applications may include examples from population biology, ecology, infectious diseases, microbiology, and genetics.
Prerequisite(s): MATH*2270, (ENGG*1500 or MATH*1160)
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4050 Topics in Mathematics I Winter Only (LEC: 3) [0.50]
In this course students will discuss selected topics at an advanced level. It is intended mainly for mathematics students in the 6th to 8th semester. Content will vary from year to year. Sample topics include: probability theory, Fourier analysis, mathematical logic, operator algebras, number theory combinatorics, philosophy of mathematics, fractal geometry, chaos, stochastic differential equations.
Offering(s): Offered in odd-numbered years.
Prerequisite(s): MATH*3200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4060 Topics in Mathematics II Winter Only (LEC: 3) [0.50]
In this course students will discuss selected topics at an advanced level as in MATH*4050, but with different choice of topic.
Offering(s): Offered in even-numbered years.
Prerequisite(s): MATH*3200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4150 Topics in Mathematics III Fall and Winter (LEC: 3) [0.50]
In this course students will discuss selected topics at an advanced level as in MATH*4050, but with different choice of topics.
Prerequisite(s): MATH*3200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4200 Advanced Analysis Winter Only (LEC: 3) [0.50]
This senior course in analysis will cover basic operator theory on Hilbert spaces, including self-adjoint operators and the spectral theorem. Other topics may include weak solutions, Sobolev spaces, inverse problems, measure theoretic probability or advanced topics from linear or nonlinear functional analysis.
Offering(s): Offered in even-numbered years.
Prerequisite(s): MATH*3200
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4240 Advanced Topics in Modeling and Optimization Fall Only (LEC: 3) [0.50]
This course is a study of advanced topics in the areas of optimization and modeling. Topics may include continuous and discrete models together with techniques for their analysis and design, and optimization topics such as game theory, networks, nonlinear problems, Markov chains, queuing theory, agent-based models, computational intelligence based techniques and computational optimization techniques.
Prerequisite(s): 0.50 credits in Mathematics at the 3000 level.
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4270 Partial Differential Equations Fall Only (LEC: 3) [0.50]
This course focuses on first and second-order partial differential equations, with examples and applications from selected fields such as physics, engineering and biology. Topics may include the wave equation, the heat equation, Laplace's equation, linearity and separation of variables, solution by Fourier series, Bessel, Legendre and Green's functions, an introduction to the method of characteristics and Fourier transforms. The classification of linear second-order partial differential equations is discussed.
Prerequisite(s): MATH*3100
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4310 Combinatorics and Graph Theory Winter Only (LEC: 3) [0.50]
This course is an introduction to combinatorics with a focus that includes graph theory. Specific topics covered are enumerative combinatorics up to inclusion-exclusion, the theory of simple graphs, Latin squares and orthogonal Latin squares, and introductory coding theory. Instructors may continue to one or more of the Polya theory of counting, graph coloring and embedding, combinatorial design theory, Ramsey theory, or advanced topics in enumerative combinatorics.
Offering(s): Offered in odd-numbered years.
Prerequisite(s): 10.00 credits including MATH*2000
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4440 Case Studies in Mathematics and Statistics Winter Only (LEC: 3) [0.50]
This capstone course for the Mathematical Science major provides students with an opportunity to synthesize knowledge and utilize problem-solving skills accumulated over the course of their studies. The course will focus on case studies drawn from engineering, computer science, biology, life and physical sciences, medicine, and/or economics.
Prerequisite(s): At least 3.0 mathematics and/or statistics credits at the 3000 level or above.
Restriction(s): Restricted to students in the Mathematical Science major.
Department(s): Department of Mathematics and Statistics
Location(s): Guelph

MATH*4600 Advanced Research Project in Mathematics Fall and Winter (LAB: 6) [1.00]
Each student in this course will undertake an individual research project in some area of mathematics, under the supervision of a faculty member. A written report and a public presentation of the project will be required. Students interested in taking this course must contact the course coordinator at least one month in advance of the first class day of the semester.
Prerequisite(s): 1.00 credits in Mathematics at the 3000 level or above.
Restriction(s): Approval of a supervisor and the course coordinator.
Department(s): Department of Mathematics and Statistics
Location(s): Guelph