MATHEMATICS (MATH)

This is a list of the Mathematics (MATH) courses available at KPU.

MATH 1102 (formerly MATH 1012) **3 Credits**
Precalculus Algebra
Students will develop the computational skills and conceptual understanding of algebra, functions, and graphs necessary to proceed to more advanced mathematics thinking. They will study equations, inequalities, graphs, functions, right angle trigonometry, and applications to problem solving. Note: Students may not use this course as science or math credit towards BSc degree.

Prerequisites: MATQ 1093; or MATQ 1099, or Pre-calculus 12 with a C-; or Principles of Mathematics 12 with a C-, or Pre-calculus 11 with a C+, or Principles of Mathematics 11 with a C+ Or Mathematics Assessment Test
Transferable (refer to transfer guide)

MATH 1112 **3 Credits**
Pre-Calculus
Students will develop the conceptual understanding and computation skills that will provide a solid foundation for the study of calculus. They will study functions, their graphs, and their applications to problem solving. In particular they will study, polynomial, rational, exponential, logarithmic, and trigonometric functions. They will develop their ability to use and understand the concepts and language of mathematics.

Prerequisites: MATH 1102 with a C; or MATH 1117 with a B; or MATQ 1093 with a B; or MATQ 1099 with an APre-calculus 12 with a C; or Principles of Mathematics 12 with a C; orPre-calculus 11 with an A; or Principles of Mathematics 11 with an A;or Mathematics Assessment Test
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1115 **3 Credits**
Statistics I
Students will summarize and display data and perform inferences about proportions, means and standard deviations for one and two populations. Students will summarize and display data, find confidence intervals, and perform hypothesis tests for proportions, means, and standard deviations, for one and two populations, both large and small. They will also perform regression analysis, and determine probabilities.

Prerequisites: One of: MATQ 0011 (B), MATQ 1093 (C), MATQ 1094 (B), MATQ 1099 (B-), MATH 1102 (C), MATH 1117 (C), Pre-calculus 12 (C), Principles of Mathematics 12 (C), Pre-calculus 11 (B), Principles of Mathematics 11 (B), Foundations of Math 12 (C), Foundations of Math 11 (B)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1116 **3 Credits**
Mathematical Explorations
Students will study the structure and development of Mathematics from the point of view of the non-mathematician. They will study historical material on the development of classical mathematical ideas as well as the evolution and structure of more recent mathematics, gaining an appreciation of historical and contemporary mathematical thinking.

This is an exploratory course in mathematics for students who have minimal mathematical background and whose major interests lie outside of the sciences. This course can be used to partially fulfill the quantitative requirement of the BA degree. It may not be used as a prerequisite for further Mathematics courses.

Prerequisites: One of: MATQ 0011 (C), MATQ 1093 (C), MATQ 1094 (C), MATQ 1099 (B-), MATH 1102 (C), MATH 1117 (C), Principles of Mathematics 11 (C), Applications of Mathematics 11 (C), Pre-calculus 11 (C), Foundations of Math 11 (C)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1117 **3 Credits**
Environmental Mathematics
Students will study algebraic concepts and methods, making use of them in general and environmental problem solving. They will study basic geometry and trigonometry, as well as functions (polynomial, rational, exponential, and logarithmic).

Prerequisites: One of: MATH 1102 (C), MATQ 1099 (C), MATQ 0011 (C), MATQ 1089 (C), MATQ 1092 (C), MATQ 1094 (C+), Pre-calculus 12 (C-), Principles of Mathematics 12 (C-), Pre-calculus 11 (C), Principles of Mathematics 11 (C), Applications of Mathematics 12 (C), Foundations of Math 11 (C+), Mathematics Placement Test
Not Transferable

MATH 1120 **3 Credits**
Differential Calculus
Students will learn to differentiate algebraic and elementary transcendental functions and to apply these skills to graphing, maxima and minima, related rates, and rectilinear motion. They will be introduced to parametric curves and their differential calculus

Prerequisites: MATH 1112 or Pre-calculus 12 with a B; or Principles of Mathematics 12 with a B; or Pre-calculus 12 with a C plus Mathematics Placement Test; or Principles of Mathematics 12 with a C plus Mathematics Placement Test
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1130 **3 Credits**
Calculus for Life Sciences I
Students will study differential calculus and its applications to biological sciences. In particular, they will study limits and differentiation of algebraic and elementary transcendental functions, with applications to graphing and optimization.

Prerequisites: MATH 1112 or Pre-calculus 12 with a C+; or Principles of Mathematics 12 with a C+; or Pre-calculus 12 with a C plus Mathematics Placement Test; or Principles of Mathematics 12 with a C plus Mathematics Placement Test
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1135 **3 Credits**
Problems and Concepts
Students will develop skills in solving mathematical problems. They will study propositional and quantifier logic and apply this knowledge to solving problems and to elementary set theory, including relations and functions.

Prerequisites: Pre-calculus 11 with a B; or Principles of Mathematics 11 with a B; or Pre-calculus 12 with a C; or Principles of Mathematics 12 with a C
Co-requisites: MATH 1112 (not required if you have Pre-calculus 12 with a C+ or Principles of Mathematics 12 with a C+) MATH 1112 (not required if you have Pre-calculus 12 with a C+ or Principles of Mathematics 12 with a C+)
Transferable (refer to transfer guide)

MATH 1140 **3 Credits**
Calculus I (Business Applications)
Students will study the differentiation of algebraic and elementary transcendental functions and apply these skills to graphing, finding maxima and minima and solving problems in business, economics and social sciences. Students will also study first and second order partial derivatives

Prerequisites: MATH 1112 with a C; or Pre-calculus 12 with a C+; or Principles of Mathematics 12 with a C+ ; or Pre-calculus 12 with a C plus Mathematics Placement Test; or Principles of Mathematics 12 with a C plus Mathematics Placement Test
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1152 **3 Credits**
Matrix Algebra for Engineers
Students will solve systems of linear equations, and study the algebra of matrices, determinants, invertibility, eigenvalues and eigenvectors, diagonalizability and systems of linear Ordinary Differential Equations (ODE's). They will study the geometry of Euclidean space, dot and cross products, the arithmetic of complex numbers, exponentials and logarithms of complex numbers, and the complex plane. Students will use a Computer Algebra System to solve problems in matrix algebra.

Prerequisites: (MATH 1120 or MATH 1130 with a C+) or (MATH 1140 with a B-) or MATH 1230 or MATH 1240
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1190 **4 Credits**
Mathematics for Elementary School Teachers
Students will study the theory and applications of arithmetic, geometry and data analysis (statistics). This course is designed for students planning a career as an elementary school teacher.

Prerequisites: Students who satisfy either (1) or (2) below are eligible to take MATH 1190. (1) One of: MATH 1112 (C), Pre-calculus 12 (C+), Principles of Mathematics 12 (C+); or Mathematics Placement Test and one of: Pre-calculus 12 (C), Principles of Mathematics 12 (C)OR (2) 18 university-level credits recognized by KPU, plus One of: MATQ 0011 (B), MATQ 1093 (C), MATQ 1094 (B), MATH 1102 (C), MATH 1115 (C), MATH 1116 (C), MATH 1117 (C), MATQ 1099 (B-), Pre-calculus 12 (C), Principles of Mathematics 12 (C), Pre-calculus 11 (B), Principles of Mathematics 11 (B), Foundations of Math 12 (C), Foundations of Math 11 (B); or Mathematics Placement Test and one of: Pre-calculus 12 (C-), Principles of Mathematics 12 (C-), Pre-calculus 11 (C), Principles of Mathematics 11 (C)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1220 **3 Credits**
Integral Calculus
Students will learn to integrate algebraic and elementary transcendental functions and to apply these skills to appropriate problems. In addition, they will learn the fundamental theorem of calculus, the integral calculus of parametric curves, Taylor polynomials, sequences and series and simple differential equations.

Prerequisites: MATH 1120 or (MATH 1130 with C +) or (MATH 1140 with a B-)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1230 **3 Credits**
Calculus for Life Sciences II
Students will study integral calculus and its applications to biological sciences. In particular, they will study the techniques of integration, including integration by parts and partial fractions; differential equations, including systems of linear differential equations; and mathematical models in the biological sciences.

Prerequisites: (MATH 1140 with a C+) or MATH 1120 or MATH 1130
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 1240 **3 Credits**
Calculus II (Business Applications)
Students will study the integration of algebraic and elementary transcendental functions and apply these skills to solving problems in business, economics and social sciences. They will also study multivariate differential calculus, differential equations, matrix algebra and linear programming.

Prerequisites: MATH 1120 or MATH 1130 or MATH 1140
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2232 **3 Credits**
Linear Algebra
Students will study systems of linear equations, matrices, determinants, eigenvalues and eigenvectors, dot products, the Gram-Schmidt process, vector and scalar projections, lines and planes in Euclidean space. Students will also study vector spaces, including general vector spaces and subspaces, linear independence, spanning sets, bases, and linear transformations. Students will write simple proofs.

Prerequisites: MATH 1120 or (MATH 1130 with a C+) or (MATH 1140 with a B-) or MATH 1230 or MATH 1240
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2315 **3 Credits**
Probability and Statistics
Students will study introductory probability and statistics using a background of calculus. Topics include concepts of randomness, probability, probability distributions for discrete and continuous random variables, descriptive statistics, multivariate distributions, laws of expectation, functions of random variables, statistical inference, and hypothesis testing. Distributions studied will include binominal, normal, t, chi-square, geometric, hypergeometry, exponential and Poisson distributions.

Prerequisites: MATH 1220 or MATH 1230 or MATH 1240
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2321 **3 Credits**
Multivariate Calculus (Calculus III)
Students will study the calculus of three dimensions. They will study vectors, lines, planes, cylinders and surfaces; vector functions, space curves and motion in space; and diferential and integral calculus of functions of several variables. Students will study optimization, including Lagrange Multipliers. They will study rectangular, polar, cylindrical, spherical and general coordinate systems. Students will study applied problems and use of a computer algebra system.

Prerequisites: MATH 1220 (or MATH 1230 with a C+) (or MATH 1240 with a B-)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2331 **3 Credits**
Introduction to Analysis
Students will study the theory that underlies calculus. In particular, they will study real numbers, limits of sequences, limits of functions, continuity, and will learn how to construct proofs involving these concepts.

Prerequisites: MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2335 **3 Credits**
Statistics for Life Sciences
Students will learn statistical techniques and their application to life sciences. They will study descriptive statistics, elementary probability, probability distributions, in particular, the binomial, normal, t and chi-square distributions, confidence intervals and hypothesis testing for population means, and proportions, as well as for differences in population means and proportions. Students will also study linear regression, and the chi-square goodness of fit test.

Prerequisites: MATH 1130 or MATH 1120 or MATH 1140
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2341 **4 Credits**
Introduction to Statistics for Business
Students will learn statistical techniques and their application to business and economics. They will study descriptive statistics, elementary probability, random variables, sampling distributions, linear regression, correlation, estimation and hypothesis testing. They will also learn how to apply statistical software to descriptive and inferential statistics. Distributions studied will include binominal, normal, t- and chi-square distributions.

Prerequisites: 9 credits numbered 1100 or higher and (MATH 1112 or Precalculus 12 or Foundations of Mathematics 12)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2410 **3 Credits**
Discrete Mathematics
Students will study the basic techniques of discrete mathematics, including methods of logic, formal reasoning, induction, recursion, counting, functions and relations, modular arithmetic, and structures such as graphs and trees.

Prerequisites: MATH 1120 or MATH 1130 or MATH 1140 or CPSC 1103
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 2721 **3 Credits**
Complex Numbers and Linear Algebra
Students will use row reduction to solve systems of linear equations. They will study the algorithms for matrix multiplication, inversion, transposition, determinants, eigenvalues and eigenvectors, and diagonalization, and apply these skills to practical problems. They will study the geometry of Euclidean space. They will study the arithmetic, exponentials and logarithms of complex numbers, and use them to solve a variety of applied problems in physics and engineering. Students will use a Computer Algebra System to solve problems in matrix algebra.

Prerequisites: MATH 1220 or MATH 1230
Transferable (refer to transfer guide)

MATH 2821 **3 Credits**
Multivariate and Vector Calculus
Students will study the principles of multivariate and vector calculus. They will study surfaces, partial derivatives, gradients, and multiple integrals in polar, cylindrical, and spherical co-ordinate systems. Students will also study derivatives of vector-valued functions, differential operators, line integrals and Green's theorem, surface integrals including the divergence and Stokes' theorems, conservative fields, and potentials, with an emphasis on applications.

Prerequisites: (MATH 1220 or MATH 1230) and (MATH 2721 or MATH 1152)
Transferable (refer to transfer guide)

MATH 3120 **3 Credits**
Introduction to Applied Mathematics
Students will learn a wide range of mathematical techniques and methods useful in applied mathematics. They will study Fourier series, Fourier integrals, Laplace and Fourier transforms; the gamma, beta, and error functions; Bessel functions, Dirac delta function, Legendre, Hermite, and Laguerre polynomials.They will also study an introduction to higher-order partial differential equations and their solutions by integral transforms and Green's Functions.

Prerequisites: MATH 2321 and (MATH 2232 or MATH 1152)
Transferable (refer to transfer guide)

MATH 3130 **3 Credits**
Introduction to the Mathematics Classroom
Students will study and implement theories related to the teaching of mathematics. They will review and investigate current and past mathematics teaching practices. They will complete a project that integrates theory with practice and produce a portfolio of written work. Students will be required to apply theory through activities such as tutoring mathematics, assisting in a classroom, or developing curriculum materials.

Prerequisites: One of: MATH 2232 (C), MATH 2321 (C), MATH 2331 (C), MATH 2410 (C). Note: EDUC 2220 (C) is recommended.
Transferable (refer to transfer guide)

MATH 3140 **3 Credits**
Mathematical Computing
Students will study the use of mathematical software such as MATLAB and Maple, and spreadsheets such as Excel to solve problems from mathematics and the applications of mathematics. They will be introduced to mathematical word-processing with LaTeX. Students are required to have a portable computer able to run software as designated by the instructor.

Prerequisites: MATH 2321 and MATH 2315 and (MATH 2232 or MATH 1152)
Transferable (refer to transfer guide)

MATH 3150 **3 Credits**
The Structure of Mathematics
Students will study the underlying structure of mathematics, including mathematical symbolism, introduction to set theory and introduction to logic. They will develop an understanding of methods of proof and an appreciation for the structure of mathematics.

Prerequisites: MATH 2232 (C) and one of: MATH 1220 (C), MATH 1230 (C+), MATH 1240 (B-)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 3160 **3 Credits**
Group Theory
Students will study the fundamental concepts and results of group theory. They will study groups and subgroups, Lagrange's theorem, homomorphisms, normal subgroups, factor groups, Cauchy's theorem and direct products.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)] and MATH 2232
Transferable (refer to transfer guide)

MATH 3170 **3 Credits**
Complex Variables
Students will study complex numbers, functions of complex numbers, analytic functions, Cauchy-Riemann equations, elementary functions, contour integration, Cauchy's integral theorem and formula, series

representations of analytic functions, poles and residues, with applications to physics and engineering.

Prerequisites: (MATH 2232 or MATH 1152 or MATH 2721) and (MATH 2321 or MATH 2821)
Transferable (refer to transfer guide)

MATH 3250 **3 Credits**
Geometry
Students will study Euclidean and other geometries, and construct geometrical proofs and objects. They will apply geometric concepts and reasoning to practical problems.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)] and MATH 2232
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 3315 **3 Credits**
Applied Inferential Statistics
Students will be introduced to the standard techniques of multiple regression analysis. They will study simple regression, ANOVA, multivariable distributions, analysis of residuals and general linear models and their role in research.

Prerequisites: 15 credits at the 1100 level or higher and one of: MATH 1115 (C), MATH 2335 (C), MATH 2341 (C), MATH 2315 (C)
Transferable (refer to transfer guide)

MATH 3322 (formerly MATH 2322) **3 Credits**
Vector Calculus (Calculus IV)
Students will study the calculus of vector valued functions and vector fields. They will study derivatives of vector valued functions, the chain rule, Jacobians and invertibility, differential operators, line integrals and Green's theorem, surface integrals including divergence and Stokes' theorems, path independence and conservative fields and potentials.

Prerequisites: MATH 2321 (C) and one of: MATH 2232 (C), MATH 1152 (C)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 3421 (formerly MATH 2421) **3 Credits**
Ordinary Differential Equations
Students will study solving first order differential equations, Laplace transforms, systems of linear differential equations, plane autonomous systems and stability, and applications of differential equations. Students will also use a computer algebra system and graphical methods in studying differential equations.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)] and (MATH 2232 or 1152)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 3431 **3 Credits**
Partial Differential Equations
Students will study the wave equation, the heat equation, Laplace's equation, and other classical equations of mathematical physics. They will study Fourier series and Fourier transforms, Sturm-Liouville Theory, Laplace transforms and partial differential equations in polar coordinates.

Prerequisites: MATH 3421
Transferable (refer to transfer guide)

MATH 3450 **3 Credits**
History of Mathematics
Students will study the aspects of the history of mathematics from its earliest beginnings in solving concrete problems through the development of abstraction and rigour in the nineteenth and early twentieth centuries. They will examine and analyze both the growth of ideas and the context in which they developed, with emphasis on the mathematics taught in secondary school and the first two years of university study.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)] and MATH 2232
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 4130 **3 Credits**
Theory of Mathematics Education
Students will explore theories and trends in mathematics education. They will survey significant historical, philosophical, psychological and societal factors influencing the development of mathematics education as a field of inquiry, and will critically examine and discuss current theories and research in mathematics instruction. They will investigate problem solving, reasoning and communication in mathematics.

Prerequisites: One of: MATH 2232 (C), MATH 2321 (C), MATH 2331 (C), MATH 2410 (C). Note: EDUC 2220 (C) is recommended.
Transferable (refer to transfer guide)

MATH 4150 **3 Credits**
Number Theory
Students will study the following topics: divisibility, properties of types of integer numbers, primes, congruences, Diophantine equations, primitive roots, and quadratic residues.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or MATH 1240 with a B-)] and MATH 2232
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 4190 **3 Credits**
Introduction to Point-Set Topology
Students will study the fundamental concepts and results of point-set (general) topology. They will study sets, relations and functions, order, cardinality, Axiom of Choice, topological spaces, bases and subbases, continuity and homeomorphisms, metric spaces, countability and compactness.

Prerequisites: [MATH 1220 or (MATH 1230 with a C+) or (MATH 1240 with a B-)] and MATH 2232 and MATH 2331
Transferable (refer to transfer guide)

MATH 4210 **3 Credits**
Biomathematics
Students will study mathematical modelling and data analysis for biological systems. They will focus on developing and analysing dynamic models of biological systems and processes. They will study the mathematics of population dynamics, models of metabolic processes, genomics and epidemiology.

Prerequisites: MATH 3421 and MATH 2315
Transferable (refer to transfer guide)

MATH 4220 **3 Credits**
Numerical Methods
Students will study the theory and practical application of numerical methods for approximating solutions of linear and nonlinear problems. They will study solutions to nonlinear equations, interpolation and splines, numerical differentiation and integration, solution of initial and boundary value problems, and error sources and analysis. Students are required to have a portable computer able to run software as designated by the instructor.

Prerequisites: MATH 2321 and (MATH 2232 or MATH 1152 or MATH 2721) and (CPSC 1103 or MATH 3140)
Transferable (refer to transfer guide)

MATH 4240 **3 Credits**
Mathematical Modelling
Students will study the formation, analysis, and interpretation of mathematical models drawn from the physical, biological, economic, and social sciences. They will study continuous and discrete, deterministic and stochastic models. Students will use techniques such as time series analysis, differential and difference equations, matrix analysis, optimization, simple stochastic processes, and numerical methods. Note: Students are required to have a portable computer able to run software as designated by the instructor.

Prerequisites: MATH 2321 and MATH 2315 and (MATH 2232 or MATH 1152)
Transferable (refer to transfer guide)

MATH 4250 **3 Credits**

Special Topics in Mathematics

Students will study a particular advanced topic in mathematics, depending upon student interest and faculty availability.

Note: Students may take this course multiple times for further credit on different topics.

Prerequisites: MATH 2232 (C) and one of: MATH 1220 (C), MATH 1230 (C+), MATH 1240 (B-)
Attributes: QUAN
Transferable (refer to transfer guide)

MATH 4350 **3 Credits**

Senior Project

Students will complete a substantial research project under the supervision of an instructor. They will identify relevant sources of information, in the form of a literature search and review, and submit a final paper investigating a research question.

Note: The student's topic must be approved by the Mathematics Department.

Prerequisites: 9 MATH credits at the 3000-level or higher
Attributes: QUAN
Transferable (refer to transfer guide)