MATH – MATHEMATICS

MATH 010C
Mathematics 10 Common
5 Credits   Weekly (6-0-0)
Mathematics 10 Common is equivalent to Alberta Education's Mathematics 10C. This course is intended to prepare students for further studies in high school mathematics. Topics studied include measurement, right triangle trigonometry, powers, irrational numbers, polynomials, factoring, functions and relations, coordinate geometry, and linear systems of equation.

MATH 010R
Mathematics 10 Prep
5 Credits   Weekly (6-0-0)
Mathematics 10 Prep is designed to meet the needs of Grade 10 students who wish to enroll in Mathematics 10 Common but do not possess the prerequisite skills. Topics include: fractions and integers, rates, ratios, proportions, percents, exponents, linear equations, polynomials, measurement and geometry. Mental math skills are emphasized throughout the course (calculators are not permitted for assessments in Mathematics 10 Prep).

MATH 020-1
Mathematics 20-1
5 Credits   Weekly (6-0-0)
Mathematics 20-1 is equivalent to Alberta Education's Mathematics 20-1 course. Topics include: quadratic functions and equations, radical expressions and equations, rational expressions and equations, the absolute value and reciprocal of functions, linear and quadratic inequalities, sequences and series, law of sines and cosines, and angles in standard position.
Prerequisites: MATH 010C or equivalent.

MATH 020-2
Mathematics 20-2
5 Credits   Weekly (6-0-0)
Mathematics 20-2 is equivalent to Alberta Education's Mathematics 20-2 course. Topics include: rates and unit rates, scale factors, inductive and deductive reasoning, laws of sines and cosines, radical expressions and equations, quadratic functions and equations, standard deviation, normal distribution, confidence intervals and margin of error.
Prerequisites: MATH 010C or equivalent.

MATH 030-1
Mathematics 30-1
5 Credits   Weekly (6-0-0)
Mathematics 30-1 is equivalent to Alberta Education's Mathematics 30-1 course. Topics include: trigonometry; exponents and logarithms; transformations and inverses of functions; polynomial, rational and radical functions; combinatorics.
Prerequisites: MATH 020-1 or equivalent.

MATH 030-2
Mathematics 30-2
5 Credits   Weekly (6-0-0)
Mathematics 30-2 is equivalent to Alberta Education's Mathematics 30-2 course. Topics studied include: set theory; permutations and combinations; probability; rational expressions and equations; exponential and logarithmic functions and equations; polynomial and sinusoidal functions.
Prerequisites: MATH 020-2 or equivalent.

MATH 030P
Pure Mathematics 30
5 Credits   Weekly (6-0-0)
Pure Math 30 is equivalent to Alberta Learning's Pure Math 30. It is designed as a preparation course for university mathematics. The course includes the following topics: trigonometry, conic sections, exponential and logarithmic functions, combinatorics, probability and statistics.
Prerequisites: MATH 020P or equivalent.

MATH 031
Mathematics 31
5 Credits   Weekly (6-0-0)
Mathematics 31 is equivalent to Alberta Education's Mathematics 31. The course will focus on the study of calculus, both as an end in of itself and as a tool in developing problem-solving skills and analytical thought processes.
Prerequisites: MATH 030-1 or equivalent.
Co-requisites: MATH 030-1 may also be taken as a co-requisite.

MATH 099
Precalculus Mathematics
3 Credits   Weekly (3-0-0)
This course reviews and extends the mathematical concepts needed to be successful in university level calculus. Topics include graphing, equations of lines, inequalities, review of elementary algebra, functions, and trigonometry. MATH 099 cannot be used to fulfill the requirements of the Bachelor of Arts, the Bachelor of Commerce, or the Bachelor of Science programs.
Prerequisites: Mathematics 30-1 or Mathematics 30-2.

MATH 100
Calculus I
3.5 Credits   Weekly (3-1-0)
This course provides an introduction to the fundamentals of calculus. The students learn about rectangular coordinates, analytic geometry, transcendental functions, inverse functions, limits, continuity, derivatives and applications, Taylor polynomials, integration and applications. Note: This course is restricted to Engineering students. Credit can only be obtained in one of MATH 100 or MATH 113 or MATH 114.
Prerequisites: Mathematics 30-1 and Mathematics 31.

MATH 101
Calculus II
3.5 Credits   Weekly (3-1.5-0)
This course provides a continuation of the study of Calculus. Students learn about techniques of integration, arc length, area of a surface of revolution, applications to physics and engineering, first order ordinary differential equations (separable and linear), infinite series, power series, Taylor expansions, polar coordinates, rectangular coordinates in R3, parametric curves in the plane and space (graphing, arc length, curvature), normal, binormal, tangent in R3. Note: This course is restricted to Engineering Program students. Credit can only be obtained in one of MATH 101 or MATH 115.
Prerequisites: Minimum grade of C- in MATH 100.

MATH 102
Applied Linear Algebra
3.5 Credits   Weekly (3-1.5-0)
This course provides an introduction to the fundamentals of linear algebra and some of their applications. The course content includes vectors and matrices; solutions of linear equations; equations of lines and planes; determinants; matrix algebra, linear transformations and their matrices; general vector spaces and inner product spaces; orthogonality and Gram-Schmidt process; eigenvalues and eigenvectors; and complex numbers. Note: This course is restricted to Engineering students. MATH 100 may be taken as a co-requisite with consent of the department. The course may not be taken for credit if credit has already been obtained in MATH 120 or MATH 125.
Prerequisites: A minimum grade of C- in MATH 100.

MATH 114
Elementary Calculus I
3 Credits   Weekly (4-0-0)
This course examines the fundamental concept of limits, differentiation and integration. Limits and differentiation of algebraic and trigonometric functions are studied along with applications including related rates, optimizing and curve sketching. This course concludes with a study of Riemann sums, the Fundamental Theorem of Calculus and substitution. Note: Students who have received credit in MATH 113 or MATH 100 may not take MATH 114 for credit.
Prerequisites: A minimum grade of 80% in Mathematics 30-1, or successful completion (50% or better) of Mathematics 31, or a minimum grade of C- in MATH 099, or successful completion of the MATH 114 gateway exam.

MATH 115
Elementary Calculus II
3 Credits   Weekly (3-1-0)
This course investigates the differentiation and integration of trigonometric, exponential and logarithmic functions. Indeterminate forms and improper integrals are studied, as well as the techniques and applications of integration. Note: Credit can only be obtained in one of MATH 115 or MATH 101.
Prerequisites: A minimum grade of C- in MATH 114.

MATH 120
Basic Linear Algebra I
3 Credits   Weekly (3-0-0)
This is an introduction to the basic notions and methods of linear algebra. Topics covered are: systems of linear equations, vectors in n-space, vector equations of lines and planes, dot product, cross product, and orthogonality, matrix algebra, invertibility of matrices, determinants, general vector spaces, basis and dimension, subspaces of n-space, rank, introduction to linear transformations, introduction to eigenvalues and eigenvectors, and applications. NOTE: This course cannot be taken for credit if credit has already been obtained in either of MATH 102 or MATH 125.
Prerequisites: Mathematics 30-1 or a minimum grade of 80% in Mathematics 30-2.

MATH 125
Linear Algebra I
3 Credits   Weekly (3-0-0)
This is an enriched introduction to the basic notions and methods of linear algebra. Topics covered are: systems of linear equations, vectors in n-space, vector equations of lines and planes, dot product, cross product, orthogonality, matrix algebra, invertibility of matrices, determinants, general vector spaces, basis and dimension, subspaces of n-space, rank, introduction to linear transformations, introduction to eigenvalues and eigenvectors, and applications. NOTE: The course covers the same basic topics as MATH 120, however it is a more rigorous course, and selected topics and applications are covered in more depth.
Prerequisites: Mathematics 30-1.

MATH 160
Higher Arithmetic
3 Credits   Weekly (3-0-0)
This course emphasizes the development of clarity in the understanding of mathematical ideas and processes, communication of these ideas to others, and application of these ideas to problem solving. Both inductive and deductive methods are explored in the study of elementary number theory, numeration systems, operations on integers and rational numbers, and elementary probability theory. Note: This course is offered to students who intend to pursue Elementary Education.
Prerequisites: Mathematics 30-1 or Mathematics 30-2 or successful completion of the gateway exam.

MATH 200
Fundamental Concepts of Math
3 Credits   Weekly (3-0-0)
This course provides an introduction to axiomatic systems and mathematical proof. These ideas are developed using examples taken primarily from set theory and number theory.
Prerequisites: A minimum grade of C- in one of MATH 114, MATH 120, or MATH 125.

MATH 214
Intermediate Calculus I
3 Credits   Weekly (3-1-0)
This course completes the study of single-variable calculus and introduces students to the basic concepts of multi-variable calculus. Topics in single-variable calculus include area and arc length of plane curves defined by parametric or polar equations, infinite series, and power series. Topics in multi-variable calculus include: vector functions and space curves, functions of several variables, and partial derivatives with applications.
Prerequisites: Minimum grade of C- in MATH 115, and in either MATH 120 or MATH 125.

MATH 215
Intermediate Calculus II
3 Credits   Weekly (3-1-0)
This course continues the study of multivariable calculus. Topics include: curves, tangent vectors, arc length; integration in two and three dimensions; polar, cylindrical and spherical coordinates; line and surface integrals, Green's, divergence and Stokes' theorems; first and second order linear differential equations.
Prerequisites: A minimum grade of C- in MATH 214.

MATH 223
Introduction to Combinatorics
3 Credits   Weekly (3-0-0)
This course is an introduction to Combinatorics covering permutations, combinations, binomial coefficients, the binomial theorem, the pigeonhole principle, inclusion-exclusion principle, generating functions, recurrences and applications to graph theory.
Prerequisites: A minimum grade of C- in any 100-level Mathematics course, not including MATH 160 or MATH 170.

MATH 225
Linear Algebra II
3 Credits   Weekly (3-0-0)
This course introduces the theory of vector spaces, inner product spaces, linear transformations and diagonalization. Specific topics of study include Euclidean n-space, spaces of continuous functions, matrix spaces, Gram-Schmidt process, QR-factorization, least squares method, change of basis, eigenspaces, orthogonal diagonalization, quadratic forms, matrices of transformations and similarity. Various applications are presented.
Prerequisites: A minimum grade of C- in either MATH 120 or MATH 125.

MATH 228
Algebra: Introduction to Ring Theory
3 Credits   Weekly (3-0-0)
This course is an introduction to the theory of rings including integral domains, division rings, ring homomorphisms, ideals, quotient rings, fields of quotients, rings of polynomials, irreducible polynomials, Euclidean domains and fields. Specific topics include the well-ordering axiom, the Binomial Theorem, the Euclidean algorithm, the Fundamental Theorem of Arithmetic, and the Chinese Remainder Theorem.
Prerequisites: Minimum grades of C- in either MATH 200 or MATH 241, and in either MATH 120 or MATH 125.

MATH 229
Abstract Algebra I
3 Credits   Weekly (3-0-0)
This course is an introduction to the theory of rings and groups, including integral domains, division rings, ring homomorphisms, ideals, groups, subgroups, cyclic groups and group homomorphisms.
Prerequisites: Minimum grades of C- in MATH 200 and one of MATH 120 or MATH 125.

MATH 241
Geometry
3 Credits   Weekly (3-0-0)
The course explores Euclidean Geometry as an axiomatic system, based on invariance under the group of isometries (rigid motions). The material includes congruence, parallelism, similarity, and the theory of measurements based on continuity axioms. The notion of circumference is introduced and treated rigorously. Problem solving is an important component of the course. The problems include proofs, finding loci, and constructions. Transformations in the Euclidean plane are used as a problem-solving tool.
Prerequisites: A minimum grade of C- in any 100-level MATH *(p. 1) course, not including MATH 160 or MATH 170.*

MATH 310
Real Analysis
3 Credits   Weekly (3-0-1)
This course presents a rigorous treatment of limit processes in one variable. Topics include real numbers, sequences, limits, continuous functions, differentiation, the Riemann integral, and the topology of the real number system.
Prerequisites: Minimum grade of C- in MATH 214 and in MATH 200.

MATH 311
Theory of Functions of a Complex Variable
3 Credits   Weekly (3-0-0)
This course provides an introduction to the fundamental concepts of single variable complex analysis. The main topics include analytic functions, complex power series, Cauchy's Integral Theorem, Cauchy's Integral Formula, the residue theorem and applications to improper real integrals and Fourier transforms.
Prerequisites: Minimum grade of C- in MATH 215.

MATH 320
Elementary Number Theory
3 Credits   Weekly (3-0-0)
Elementary methods in number theory are presented. The following topics are included: divisibility, linear Diophantine equations, prime numbers, the fundamental theorem of arithmetic, congruences, the Chinese remainder theorem, Fermat's little theorem, arithmetic functions, Euler's theorem, primitive roots, and quadratic residues.
Prerequisites: Minimum grade of C- in MATH 200; a minimum grade of C- in MATH 228 is recommended.

MATH 321
Fields and Modules
3 Credits   Weekly (3-0-0)
This course builds on the knowledge of rings and fields obtained in MATH 228, and introduces the student to basic module theory. Topics studied include finite fields, quadratic number fields and algebraic field extensions, the Fundamental Theorem of Algebra, modules, and Noetherian rings.
Prerequisites: Minimum grade of C- in MATH 225 and MATH 228.

MATH 325
Matrix Theory and Applications
3 Credits   Weekly (3-0-0)
This course develops the study of matrices and their applications by way of special classes of matrices and matrix structure theorems. The main application will be to optimization problems.
Prerequisites: Minimum grades of C- in MATH 225 and MATH 114.

MATH 329
Abstract Algebra II
3 Credits   Weekly (3-0-0)
This course continues the study of Abstract Algebra begun in Math 229 and studies rings of polynomials, divisibility, irreducibility, quotient rings, Euclidean domains, PIDs and UFDs, normal subgroups, quotient groups and the Sylow theorems.
Prerequisites: A minimum grade of C- in MATH 229.

MATH 330
Ordinary Differential Equations
3 Credits   Weekly (3-2-0)
This course provides techniques for solving ordinary differential equations and systems of first order equations and investigates the qualitative nature of solutions of dynamical systems. Topics covered include first order equations, linear equations of higher order and linear dynamical systems with constant coefficients.
Prerequisites: Minimum grades of C- in MATH 214, and in either MATH 120 or MATH 125.

MATH 335
Numerical Methods
3 Credits   Weekly (3-2-0)
This course presents numerical methods for solving problems in linear algebra, non-linear equations, interpolations, approximation of functions, differentiation and integration. The numerical algorithms are illustrated using an appropriate computer programming language and specific libraries.
Prerequisites: Minimum grades of C- in MATH 214, CMPT 101, and one of MATH 120 or MATH 125.

MATH 336
Introduction to Optimization
3 Credits   Weekly (3-1-0)
This course focuses on optimization (or mathematical programming) and its applications. Topics will include but are not limited to classical optimization for unconstrained problems with steepest descent and conjugate gradient methods, and for constraint optimization with linear programming, the simplex method, Lagrangean method and Karush-Kuhn-Tucker (KKT) conditions. Emphasis will be placed both on the mathematical techniques and on model formulation through examples from applications.
Prerequisites: Minimum grades of C- in MATH 120 or MATH 125, MATH 115, CMPT 101 and one of CMPT 200 or MATH 214.

MATH 341
Modern Geometries
3 Credits   Weekly (3-0-0)
This course explores Euclidean and Non-Euclidean plane geometries from the viewpoint of Klein's Erlangen program, based on invariance under groups of transformations in the extended complex plane. Mobius geometry is introduced, and Euclidean, hyperbolic, and elliptic geometries are studied as its subgeometries. The differences in axiomatics and results of the Euclidean and Lobachevsky – Bolyai geometries are discussed based on the disc model of hyperbolic geometry. Elliptic geometry is considered as another Mobius subgeometry.
Prerequisites: Minimum grades of C- in MATH 241, and in either MATH 120 or MATH 125.

MATH 350
Introduction to Graph Theory
3 Credits   Weekly (3-0-0)
This course discusses graphs and digraphs, paths and cycles, trees, planarity, colouring problems and matching problems. In addition, graph algorithms and some applications to other disciplines are studied.
Prerequisites: Minimum grades of C- in either MATH 120 or MATH 125, and in either MATH 200 or MATH 223.

MATH 361
History of Mathematics
3 Credits   Weekly (3-0-0)
The course is a survey of the history of mathematics from ancient times through the development of calculus and the origins of modern algebra in the nineteenth century. It emphasizes the events that led to the development of modern and classic mathematics from a problem solving perspective. Biographies of famous mathematicians complement the abstract concepts of mathematics.
Prerequisites: Minimum grade of C- in any two 200-level MATH *(p. 1) courses.*

MATH 398
Independent Study
3 Credits   Total (0-0-45)
This course permits an intermediate-level student to work with an instructor to explore a specific topic from mathematics in depth through research or directed reading in primary and secondary sources. The student plans, executes and reports the results of their independent research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit.

MATH 410
Analysis and Topology
3 Credits   Weekly (3-0-0)
This course continues the study of Analysis begun in MATH 310 and examines differentiation and integration in Rn. Specific topics covered will include: implicit and inverse functions theorems, Fubini's theorem, differential forms, and the generalized Stokes' theorem.
Prerequisites: Minimum grade of C- in MATH 225 and MATH 310.

MATH 420
Groups and Galois Theory
3 Credits   Weekly (3-0-0)
This course is a treatment of symmetry, beginning with groups, then developing the ideas of Galois theory, and finishing with the quintic equation. Topics include groups, normal subgroups, quotient groups, Cayley's Theorem, the Class equation, permutations, group actions, the Sylow theorems, splitting fields, Galois extensions, the Main Theorem of Galois theory, Kummer extensions, cubic, quartic and quintic equations.
Prerequisites: Minimum grade of C- in MATH 321.

MATH 428
Introduction to Galois Theory
3 Credits   Weekly (3-0-0)
This course is an introduction to Galois Theory, covering topics such as algebraic extensions, algebraic closure, splitting fields, Galois extensions, the Galois group, the fundamental theorem of Galois theory and solvability of polynomial equations via radicals.
Prerequisites: A minimum grade of C- in MATH 329.

MATH 429
Introduction to the Theory of Modules
3 Credits   Weekly (3-0-0)
This course is an introduction into the theory of modules over rings and covers topics as modules, homomorphisms and isomorphisms, quotient modules, free modules, generators, tensor products, Noetherian rings and modules.
Prerequisites: A minimum grade of C- in MATH 329.

MATH 430
Applied Dynamical Systems
3 Credits   Weekly (3-1-0)
This course presents an introduction to dynamical systems related to ordinary differential equations in the continuous case, or to difference equations in the discrete case. Elementary existence and uniqueness theorems and stability are considered for linear and non-linear systems of ordinary differential equations. Periodic solutions, chaotic attractors, an introduction to bifurcation theory, basic notions of discrete dynamical systems, and deterministic chaos are discussed. Applications are chosen from biology, physics and other areas.
Prerequisites: Minimum grade of C- in MATH 310 and MATH 330.

MATH 436
Introduction to Partial Differential Equations
3 Credits   Weekly (3-2-0)
The goal of this course is to introduce the student to the mathematical modeling of classical physical systems such as vibrating systems, diffusive processes and steady state phenomena. The course starts with a rigorous introduction of the first-order and linear second-order partial differential equations (PDEs) followed by elements of Fourier analysis. The method of characteristics is used to find and interpret classes of solutions for the above models. The lab component will familiarize the student with formal and numerical manipulations of PDE's. The main scope of the lab is to enable the student to visualize and discuss solutions for classical models for PDE's.
Prerequisites: Minimum grades of C- in MATH 310 and MATH 330.

MATH 495
Special Topics in Mathematics
3 Credits   Weekly (3-0-1)
This course examines an advanced topic of specialization in mathematics. The instructor chooses the topic in any given semester. Students can take this course up to three times, provided the course topic is different.
Prerequisites: A minimum grade of B- in a 300-level MATH *(p. 1) course and consent of the department.*

MATH 498
Advanced Independent Study in Mathematics
3 Credits   Total (0-0-45)
This course permits a senior-level student to work with an instructor to explore a specific topic from mathematics in depth through research or directed reading in primary and secondary sources. The student plans, executes and reports the results of their independent research or study project under the direction of a faculty supervisor. To be granted enrollment in the course, the student must have made prior arrangements with a faculty member willing to supervise his or her project. This course can be taken twice for credit.

MATH 499
Honours Thesis
3 Credits   Total (0-0-45)
Under the direction of a faculty supervisor, registered students explore a specific topic in depth through research or directed reading. The student plans, executes, and reports the results of their independent research or study project under the direction of a faculty supervisor in a written Honours Thesis with oral defense. Note: This course is intended for students in the final year of their degree and is open only to students in the Mathematics Honours program.
Prerequisites: Consent of the Department.