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CURRICULUM GUIDE: OFFICIAL COURSE OUTLINE

<table>
<tr><td>Course Code</td><td>MATH 115</td><td>Course Title</td><td colspan="4">Discrete Mathematics</td></tr>
<tr><td>Credit Value</td><td>3</td><td>Department</td><td colspan="4">Mathematics and Science</td></tr>
<tr><td rowspan="2">No. of weeks</td><td rowspan="2">14</td><td rowspan="2">Hrs. per week</td><td>Lecture</td><td>Tutorial</td><td>Laboratory</td><td>Total</td></tr>
<tr><td>4</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>Course Description</td><td colspan="6">Offers an intensive introduction to discrete mathematics. Topics include: functions and relations, sets theory, cardinality, propositional and predicate logic, fundamental principles of counting and logic, proof techniques, combinatorics, properties of integers, discrete probability, asymptotic notation, graphs and trees, and an introduction to elementary number theory and abstract algebra. The course will provide a basis to study higher level mathematics and computing science.

Note: Students with credit for CPSC 115 may not take MATH 115 for further credit.</td></tr>
<tr><td>Prerequisite(s)</td><td colspan="6">ENGL 088 (formerly EASL 089/ENGL 097), MATH 12 (C) or MATH 100 (C)</td></tr>
<tr><td rowspan="2">Initial Articulation Targets</td><td>UBC</td><td>SFU</td><td>UVic</td><td>UNBC</td><td colspan="2">TRU</td></tr>
<tr><td>CPSC 1st (3), exempt from UBCV CPSC 121 (4)</td><td>MACM 101 (3)</td><td>MATH 122 (1.5)</td><td>CPSC 141 (3)</td><td colspan="2"></td></tr>
<tr><td colspan="6">For updated information on the transferability of this course, please consult the BC Transfer Guide, www.bctransferguide.ca</td></tr>
<tr><td>Learning Outcomes</td><td colspan="6">Upon successful completion of this course, the student will be able to:
Describe the basic concepts of set theory and construct proofs based on those concepts
Use principles of cardinality to determine the countability of sets
Solve numerical problems using fundamental counting algorithms
Describe the concept of an algorithm and determine its complexity
Construct proofs using laws of logic, inductive methods, pigeonhole principle, etc.
Identify the basic concepts of graphs and trees and use those concepts to solve problems
Use the basic concepts of rings and groups to identify isomorphic and homomorphic sets
Solve applications including finite-state machines, RSA-encryption, and counting problems</td></tr>
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Content	**Core** topics – all of the following will be covered:
	• Fundamental Principles of Counting
	  ○ Rule of sum and product
	  ○ Permutations
	  ○ Combinations
	  ○ Combinations with repetition
	  ○ The Catalan numbers
	• Fundamentals of Logic
	  ○ Basic connectives and truth tables
	  ○ Logical equivalence: the laws of logic
	  ○ Logical implication: rules of inference
	  ○ The use of quantifiers
	  ○ Quantifiers, definitions, and the proofs of theorems
	• Set Theory
	  ○ Sets and subsets
	  ○ Set operations and the laws of set theory
	  ○ Counting and Venn diagrams
	  ○ Introductory probability
	  ○ Russell's Paradox and axiomatic set theory
	• Properties of Integers
	  ○ The well-ordering principle: mathematical induction
	  ○ Recursive definitions
	  ○ The division algorithm: prime numbers
	  ○ Greatest common divisor: the Euclidean algorithm
	  ○ The fundamental theorem of arithmetic
	• Relations and Functions
	  ○ Cartesian products and relations
	  ○ Functions: plain and one-to-one
	  ○ Cardinality of infinite sets: countability
	  ○ Onto functions: Stirling numbers of the second kind
	  ○ Special functions
	  ○ The Pigeonhole principle
	  ○ Function composition and inverse functions
	  ○ Computational complexity
	  ○ Analysis of algorithms
	• Languages: Finite State Mechanics
	  ○ Language: the set theory of strings
	  ○ Finite state machines
	• Relations Revisited
	  ○ Properties of relations
	  ○ Zero-one matrices and directed graphs
	  ○ Partial orders: Hasse diagrams

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Equivalence relations and partitions
Finite state machines: the minimization process

Introduction to Graphs and Trees

Definitions and examples of graphs
Subgraphs, complements, and graph isomorphism
Definitions, examples, and properties of trees
Shortest path algorithm

Groups, Rings, and Modular Arithmetic

Group structure: definition and examples
Homomorphisms, isomorphisms, and cyclic groups
Ring structure: definition and examples
Ring properties and substructures
The Integers modulo n
The Chinese remainder theorem
RSA-Encryption
Ring homomorphisms and isomorphism

Additional topics may also be covered, at the discretion of the instructor.
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<tr><td>Methods of Instruction</td><td>Lectures, tutorial, problem-based learning, group work</td></tr>
<tr><td>Required Textbook(s)</td><td>The following textbook(s) is/are required, or approved equivalent(s).

Doerr, Alan and Kenneth Levasseur. Applied Discrete Structures. Open Textbook Library, 2021.

Grimaldi, Ralph P. Discrete & Combinatorial Mathematics: An Applied Introduction. 5th Ed. Pearson Education, Inc. 2004.

Levin, Oscar. Discrete Mathematics: An Open Introduction. 3rd Ed. Open Math Books, 2022.</td></tr>
<tr><td>Required Equipment and Technology</td><td>Students are required to have a computer with internet access.
The following resources are provided by the College:

Office 365
Student email

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<tr><td>Homework Hours</td><td>At minimum, students can expect one hour of homework for every hour of instructional time.</td></tr>
<tr><td>Evaluation</td><td>
<table>
<tr><th>Component</th><th>% Value</th></tr>
<tr><td>Assignments, in-class activities, participation</td><td>10-30%</td></tr>
<tr><td>Quizzes (weekly, biweekly, module, chapter)</td><td>10-30%</td></tr>
<tr><td>Midterm examination(s)</td><td>20-30%</td></tr>
<tr><td>Final examination</td><td>30-35%</td></tr>
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Completion Requirements	The minimum grade to pass this course is D (50%). Unless otherwise stated, a minimum grade of C- (55%) is required for this course to fulfil a prerequisite.		
Course Designer(s)	Keira Gunn, MSc., Department of Mathematics, Alexander College	Consultant(s), *if applicable*	Len Berggren, Ph.D., Department of Mathematics, Simon Fraser University
Dean's Approval	Barbara Moon, Ph.D., Dean of Arts and Sciences, Alexander College	Dean's Approval Date	February 28, 2016
Curriculum Committee Approval Date	February 28, 2016	First Term Offered	Winter 2017
Last Review Date	March 1, 2023	Next Review Date	March 1, 2028
Revision History	May 1, 2014-All MATH and STAT courses will be 4 hours, commencing Fall 2014, per SASC. March 1, 2023-Minor updates (e.g., assessment ranges, textbooks) by Kelly Cheung and Krishna Subedi		

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