CURRICULUM GUIDE: OFFICIAL COURSE OUTLINE

Course Code	MATH 232	Course Title	Elementary Linear Algebra			
Credit Value	3	Department	Mathematics and Science			
No. of weeks	14	Hrs. per week	*Lecture*	*Tutorial*	*Laboratory*	*Total*
			4	0	0	4
Course Description	Matrix arithmetic, linear equations, and determinants. Real vector spaces and linear transformations. Inner products and orthogonality. Eigenvalues and eigenvectors.					
Prerequisite(s)	ENGL 088 (formerly EASL 089/ENGL 097), MATH 104 (B) or MATH 105 or MATH 151					

	UBC	*SFU*	*UVic*	*UNBC*	*TRU*
Initial Articulation Targets	MATH 221 (3)	MATH 232 (3) – Q	MATH 211 (1.5)	MATH 220 (3)	MATH 2120 (3)
	For updated information on the transferability of this course, please consult the BC Transfer Guide, www.bctransferguide.ca				

Learning Outcomes	Upon successful completion of this course, the student will be able to: • Solve systems of linear equations using matrices (including Gaussian and Gauss-Jordan elimination). • Solve problems using matrix operations, their properties, and various characterizations of invertible matrices. • Calculate determinants, demonstrate an understanding of their properties, and apply them to solve a system of linear equations using adjoint matrix method and Cramer's Rule. • Solve problems using vectors in 2- and 3-space, dot and cross products, lines and planes, and generalize them to more than three dimensions. • Solve problems involving linear combinations, linear dependence, linear independence, the span of a set of vectors, bases and dimension in Rn • Solve problems by using the axiomatic approach to vector spaces and subspaces, and inner product spaces, and complete simple proofs using axioms and other similar properties. • Solve problems using the concept of linear transformation and the representation of these transformations as matrices, and find the kernel, rank, range and nullity of a linear transformation. • Compute eigenvalues and eigenvectors, and use them in diagonalization problems and other applications including probability and systems of differential equations. • Compute the orthogonal projection of a vector onto another vector, and solve applications including least-squares approximation and distance minimization in 3-space.

Content	**Core** topics – all of the following will be covered: Linear Equations • Systems of linear equations • Row reduction and echelon form • Vector equations • The matrix equation Ax-b • Solution sets of linear systems • Linear independence • Introduction to linear transformations • The matrix of a linear transformation Matrix Algebra • Matrix operations • The inverse of a matrix • Characterizations of invertible matrices Determinants • Properties of determinants • Cramer's rule • Volume and linear transformations Vector Spaces • Vector spaces and subspaces • Null spaces • Column spaces and linear transformations • Linearly independent sets • Bases • Coordinate systems • The dimension of a vector space • Rank • Change of basis Eigenvectors and Eigenvalues • The characteristic equation • Diagonalization • Eigenvectors and linear transformations • Complex eigenvalues Orthogonality and Least Squares • Inner product • Length and orthogonality • Orthogonal sets • Orthogonal projections • The Gram-Schmidt process

	• Least-squares problems • Inner product space Symmetric Matrices • Diagonalization of symmetric matrices Additional topics may also be covered, at the discretion of the instructor.
Methods of Instruction	Lectures, tutorial, problem sessions, assignments
Required Textbook(s)	The following textbook(s) is/are required, or approved equivalent(s). Lay, David et al. Linear Algebra and its Applications 6th Ed. Pearson, 2020.
Required Equipment and Technology	Students are required to have a computer with internet access. The following resources are provided by the College: • Office 365 • Student email
Homework Hours	At minimum, students can expect one hour of homework for every hour of instructional time.

Evaluation	Component	% Value
	Assignments, in-class activities, participation	10-30%
	Quizzes (weekly, biweekly, module, chapter)	10-30%
	Midterm examination(s)	20-30%
	Final examination	30-35%

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)	Len Berggren, Ph.D., Department of Mathematics, Simon Fraser University	Consultant(s), *if applicable*	
Dean's Approval	Barbara Moon, Ph.D., Dean of Arts and Sciences, Alexander College	Dean's Approval Date	September 27, 2006
Curriculum Committee Approval Date	September 27, 2006	First Term Offered	Winter 2007
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.
	January 5, 2015-Revision by Len Berggren, Mathematics faculty
	March 1, 2023-Minor updates (e.g., assessment ranges, textbooks) by Kelly Cheung and Krishna Subedi