Title (Units): **COMP2027 Applied Linear Algebra for Computing (3,2,1)**

Course Aims: This subject studies various linear algebra topics such as vectors, matrices, linear equations, eigenvalues, eigenvectors, matrix factorizations, singular value decomposition, optimization problems, curve fitting, and software packages for these problems. Emphasis is given to understanding the nature of these problems, and using mathematical tools to solve the problems. Applications of these problems in computer science fields such as machine learning, data analytics, computer graphics, and pattern recognition will be introduced.

Prerequisite: MATH1025 Introduction to Mathematics and Statistics or
MATH2005 Calculus, Probability and Statistics for Computer Science

Course Intended Learning Outcomes (CILOs):
Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
	Knowledge
1	Solve linear algebra problems of vectors and matrices
2	Understand matrix factorization problems such as singular value decomposition
3	Fit curves on a data set
4	Understand different classes of optimization problems
	Professional Skill
5	Write programs using a scripting language such as Matlab
6	Use mathematical software to solve linear algebra problems

Calendar Description: This subject studies various linear algebra topics such as vectors, matrices, linear equations, eigenvalues, eigenvectors, matrix factorizations, singular value decomposition, optimization problems, curve fitting, and software packages for these problems. Emphasis is given to understanding the nature of these problems, and using mathematical tools to solve the problems. Applications of these problems in computer science fields such as machine learning, data analytics, computer graphics, and pattern recognition will be introduced.

Teaching and Learning Activities (TLAs):

CILOs	Type of TLA
1 - 2	Students will learn basic concepts and skills in vectors, matrices, linear equations, eigenvalues, eigenvectors, matrix factorizations, and singular value decomposition.
3 - 4	Students will learn and practice the skills in using the linear algebra knowledge to solve optimization problems and curve fitting problems.
5 - 6	Students will learn and practice Matlab programming language and linear algebra software packages in lectures and tutorials.
1 - 6	Students will work on assignments, programming problems, written and/or practical tests, and examination to enhance their understanding of linear algebra.

Assessment:

No.	Assessment Methods	Weighting	CILOs to be addressed	Description of Assessment Tasks
1	Continuous Assessment	40%	1-6	Continuous assessments are designed to measure how well students have learned the basic concepts and skills of linear algebra. Written and/or practical tests, written assignments, and programming problems will be given to access CILOs 1-6.
2	Examination	60%	1-6	Final examination questions are designed to evaluate how far students have achieved their intended learning outcomes. Questions will primarily be analysis and skills based to assess the

				student's ability in the understanding and application of linear algebra.

Assessment Rubrics:

Excellent (A)	• Achieve all CILOs, demonstrating a good mastery of both the theoretical and practical aspects of the knowledge and skills associated with linear algebra. • Able to develop correct solutions to a lot of problems in linear systems and matrix factorizations. • Able to apply a variety of software skills to solve problems in curve fitting and optimization.
Good (B)	• Achieve most of the six CILOs, demonstrating a good understanding of the knowledge and skills associated with linear algebra. • Able to develop correct solutions to problems in linear systems and matrix factorizations. • Able to apply selected software skills to solve problems in curve fitting and optimization.
Satisfactory (C)	• Achieve some of the six CILOs, demonstrating a basic level of understanding of the knowledge and skills associated with linear algebra. • Able to provide acceptable solutions to some problems in linear systems and matrix factorizations. • Able to apply some software skills to solve problems in curve fitting and optimization.
Fail (F)	• Achieve none of the six CILOs, with little understanding of the associated linear algebra. • Unable to provide solutions to simple problems in linear systems and matrix factorizations. • Unable to apply any software skills to solve problems in curve fitting and optimization.

Course Content and CILOs Mapping:

Content		**CILO No.**
I	Vectors and matrices	1-4, 6
II	Curve fitting	3, 5-6
III	Matrix factorizations	1-2, 4-6
IV	Optimization	1-2, 4-6
V	Software tools for linear algebra	1-6

References:

- Gilbert Strang, Linear Algebra and its Applications, 4th edition, Thomson Brooks, 2006.
- David Lay, Stephen Lay, and Judi McDonald, Linear Algebra and its Applications, 5th edition, Pearson, 2016.
- William Palm III, Introduction to MATLAB for Engineers, 3rd edition, McGraw Hill, 2011.

Course Content:

Topic

I. Vectors and matrices
   A. Vector operations, dot products, cross products
   B. Matrix operations, transposes, inverses, determinants
   C. Equations of surfaces
   D. Solutions of systems of linear equations
   E. Eigenvalues and eigenvectors

II. Curve fitting
   A. Linear interpolation
   B. Polynomial interpolation
   C. Applications in computer graphics

III. Matrix factorizations
   A. Gaussian elimination and LU decomposition
   B. Orthogonal matrices
   C. QR Decomposition
   D. Singular value decomposition

IV. Optimization
   A. Orthogonal projection
   B. Least-squares problems
   C. Introduction to optimization problems
   D. Linear regression

V. Software tools for linear algebra
   A. Scripting languages such as Matlab
   B. Linear equation solver
   C. Linear regression and optimization packages
   D. Singular value decomposition software
   E. Real life example problems (e.g., from machine learning, data analytics, and pattern recognition) requiring linear algebra