DEREE COLLEGE SYLLABUS FOR: MA 2027 LINEAR ALGEBRA 3/0/3

UK LEVEL: 4
UK CREDITS: 15

(FALL 2025)

PREREQUISITES:	None
CATALOG DESCRIPTION:	A course intended to provide mathematical background in the algebra of matrices and vector spaces. Main topics include methods of solutions of linear systems, vector spaces, linear transformations, inner products, eigenvalues, eigenvectors, quadratic forms, matrix decompositions, singular value decomposition, and applications.
RATIONALE:	This algebra course deals with the study of linear systems, linear transformations, vector spaces, and matrix decomposition methods and diagonalization. It aims to provide students with a solid foundation in these concepts and their applications in various fields such as natural sciences, engineering, computer science, economics, finance, and other.
LEARNING OUTCOMES:	*As a result of taking this course, the student should be able to:* 1. Use various techniques to classify and solve linear systems of equations. 2. Demonstrate understanding of the geometry of real vector spaces and compute bases for matrix spaces. 3. Utilize linear transformations and understand the concepts of orthogonality and diagonalization. 4. Apply various matrix decomposition methods to analyze, solve, and model real-world applications.
METHOD OF TEACHING AND LEARNING:	In congruence with the teaching and learning strategy of the college, the following tools are used: • Lectures and class discussions. • Homework assignments. • Office hours held by the instructor to provide further assistance to students. • Use of library facilities for further study and preparation for the exams. • Use of the Blackboard course management platform to further support communication, by posting lecture notes, assignment instruction, timely announcements, formative quizzes and online submission of assignments.
ASSESSMENT:	**Summative:** 1st assessment: Midterm examination (written, 1 hour) **30%** 2nd assessment: Portfolio of student work **10%** Final assessment: Final examination (written, 2 hours) **60%** ▪ The first assessment tests Learning Outcomes 1 and 2. ▪ The second assessment tests Learning Outcomes 1, 2, 3, and 4. ▪ The final assessment tests Learning Outcomes 1, 2, 3, and 4. ▪ The formative assessment aims to prepare students for the examinations. The final grade for this module will be determined by averaging all summative assessment grades, based on the predetermined weights for each assessment. If students pass the comprehensive assessment that tests all Learning Outcomes for this module and the average grade for the module is 40 or higher, students are not required to resit any failed assessments. Students are required to resit failed assessments in this module.
INDICATIVE READING:	**REQUIRED READING:** • H. Anton, C. Rorres, A. Kaul, *Elementary Linear Algebra: Applications version*, 12th Edition (2019), Wiley **RECOMMENDED READING:** • R. Larson, *Elementary Linear Algebra*, 8th Edition (2017), Cengage • D. C. Lay, S. R. Lay, J. J. McDonald, *Linear Algebra and Its Applications*, 5th Edition (2016), Pearson

INDICATIVE MATERIAL:	**REQUIRED MATERIAL:** N/A **RECOMMENDED MATERIAL:** • College Mathematics • Mathematics Magazine • American Mathematical Monthly
COMMUNICATION REQUIREMENTS:	Oral and written communication skills using academic / professional English.
SOFTWARE REQUIREMENTS:	MS Office and Blackboard CMS. Python (www.python.org) *or* Scilab (www.scilab.org)
WWW RESOURCES:	http://mathworld.wolfram.com http://mathacademy.com https://www.khanacademy.org/math
INDICATIVE CONTENT:	**1. Linear Systems and Matrices** 1.1. Systems of linear equations 1.2. Matrices, vectors and Gaussian elimination 1.3. Matrix operations – Invertible matrices 1.4. Determinants and Cramer's rule 1.5. Applications of linear systems **2. Euclidean Vector Space** 2.1. Vectors in R^2, R^3, and R^n 2.2. Norm and distance in R^n 2.3. Dot product and orthogonality **3. Vector Spaces** 3.1. Real vector spaces and subspaces 3.2. Linear independence 3.3. Basis for a vector space and dimension 3.4. Matrix spaces – Rank, Nullity **4. Linear Transformations** 4.1. Introduction to linear transformations 4.2. General linear transformations and isomorphisms 4.3. Compositions and inverse transformations **5. Inner Product Spaces** 5.1. Inner products and orthogonality 5.2. Gram-Schmidt process and QR-Decomposition 5.3. Least squares solutions of linear systems **6. Diagonalization and Symmetry of Matrices** 6.1. Eigenvalues and eigenvectors 6.2. Matrix diagonalization and symmetric matrices 6.3. Orthogonal matrices and orthogonal transformations 6.4. Orthogonal diagonalization 6.5. Quadratic forms **7. Matrix Factorization** 7.1. LU-Decomposition 7.2. Singular Value Decomposition