COURSE SYLLABUS

Course Title: **Linear Algebra**

Abbreviated Title As Appears on Transcript: Linear Algebra

Course Number: DMAT 335

Credit Hours: 4 credits [semester credit hours]

Course Description: A first course in matrix algebra and linear spaces with emphasis on computational software techniques and geometrical analysis. Topics include matrices, solutions of systems of linear equations, determinants, linear spaces and transformations, inner products, higher dimensional spaces, inverses and pseudoinverses, rank, Singular Value Decomposition, bases, rank, Eigenvalues and Eigenvectors, matrix decomposition and diagonalization.

Prerequisite: Successful completion (C- or higher) of Calculus II or equivalent, or consent of instructor.

Course Workload: 4 semester credit hours • 3 student work hours per credit hour • 14 week Carnegie semester = 168 hours student course workload average

Examination Requirements: Proctored written and oral final examination must be passed at 70% or higher to earn passing grade in course. "B" and "A" grade paths have additional examinations and assignments. See https://www.distancecalculus.com/grades/ for more information.

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Accredited by New England Commission of Higher Education (NECHE).
See https://www.rwu.edu/academics/accreditation/ for more information.

E-Textbook:

Matrices, Geometry & LiveMath by Robert R. Curtis, Ph.D., adapted from Davis/Porta/Uhl *Vector Calculus&Mathematica* courseware series

Mathematical Software: LiveMath and Mathematica Computer Algebra & Graphing Systems

ADA ACCOMMODATIONS

Roger Williams University has a continuing commitment to providing reasonable accommodations for students with documented disabilities. Students with disabilities who need accommodations in order to fully participate in this class are urged to contact Student Accessibility Services, as soon as possible, to explore the arrangements needed to be made to assure access. Student Accessibility Services is open Monday through Friday from 8:00AM to 5:00PM Eastern Time; Email: sas@rwu.edu or Voice: 401-254-3841. For more information about SAS, visit https://www.rwu.edu/undergraduate/academics/student-academic-success/student-accessibility-services-sas

COURSE RULES

Academic Honesty	Academic Dishonesty in a Distance course includes copying or relying upon another person's work. Working with other students is good and encouraged, but the work you submit for this course must be genuinely your own work. Private tutors are allowed, but you must notify the instructor that you have obtained a private tutor to aid in your studies. Any documented instance of Academic Dishonesty will be grounds for immediate failure in this course.
Final (and Other) Examinations	A written and oral proctored final exam will occur at the student's location over video with the course professor; The student must score 70% or higher on this final exam to be eligible to earn a passing grade in the course.
Communication	Communication is the key to success in a Distance course. It is the student's responsibility to keep good communication channels with the instructors during the course; failure to participate in the course does not constitute "dropping" the course (Withdrawal from the course must be requested in writing to the instructors before the completion date deadline)
Roger Williams University Policies & Procedures	Roger Williams University has Policies & Procedures that all students must follow, including the Roger Williams University Student Handbook. Student must agree to follow all stated rules governing student conduct listed on the Roger Williams University website, and at the Roger Williams University Course Catalog
Course Completion 1 Year Rule	All Distance Calculus students are afforded 1 Year to finish their course from the Date of Enrollment. Students will be placed in the Academic Semester based upon their Date of Enrollment for academic records purposes. If a student does not finish the course, and does not request a Course Withdrawal for a W, then an "F" grade will be issued.
No Chatbots / AI	Students must pledge to **not** use any Chatbot/AI at all - **period**. Student must pledge to **limit** use of search engines (Google, Bing, etc) to a minimal level. Student must pledge to not engage in dishonest disguise of any Chatbot/AI/Search Engine source of information as student's own honest academic work. Verified chatbot usage will result in an "F" course grade, and will be referred to the Roger Williams University Academic Integrity Committee.

Learning Outcomes for DMAT 335 - Linear Algebra

1. To understand the core connection between matrix algebra and a study of systems of linear equations
2. To understand and compute measurements of vectors and their geometry
3. To understand and compute core matrix algebra operations and their geometrical interpretations
4. To understand and compute the fundamental properties of determinants and inverses of matrices, both for square and non-square generalizations
5. To understand and compute Singular Value Decomposition
6. To understand and compute the core concept of rank and its variations
7. To understand and compute Gaussian elimination and other strategies for finding solutions or approximate solutions to systems of linear equations
7. To understand and compute bases, change of bases, spanning and linear independence, kernel and image sets
8. To understand and compute the diagonalization of a matrix, both with Singular Value Decomposition, and Eigenvalue - Eigenvector constructions.
9. To understand orthogonalization and the Gram-Schmidt process.

Syllabus Topics Outline for DMAT 335 - Linear Algebra

1. Getting Started
   - 1.1 Email and Chat
   - 1.2 Learning About the Course
   - 1.3 Required Hardware
   - 1.4 Software Fundamentals

2. Vectors
   - 2.1 Geometry of Vectors
   - 2.2 Perpendicular Frames
   - 2.3 Curves in 2D: Change of Frames / Basis
   - 2.4 Dot Products
   - 2.5 Cross Products
   - 2.6 Ellipses and Ellipsoids
   - 2.7 Area and Volume
   - 2.8 Closest Points
   - 2.9 Building Perpendicular Frames in 3D
   - 2.10 Hanging Curves and Surfaces onto Perpendicular Frames

3. Matrices
   - 3.1 Matrix Addition and Multiplication
   - 3.2 Matrices Transforming Curves
   - 3.3 Translations, Rotations, Shears, Rigid Motions
   - 3.4 Hanging, Aligning, Stretching, and Rotating
   - 3.5 Linearity of Matrix Transformations

4. Hangers, Aligners, and Stretchers

4.1 Core Concept: A.aligner = stretch * hanger
4.2 Geometry of Matrix Transformations
4.3 Matrix Inverses & Transposes
4.4 Perpendicular Projection
4.5 Reflections
4.6 Right and Left Orientations

5. Singular Value Decomposition in 2D & 3D
5.1 Using SVD to obtain aligners, hangers, stretchers for any matrix
5.2 SVD Geometry of Matrix Inversion & Transpose
5.3 Solving Linear Equations & Geometry of SVD
5.4 Determinants
5.5 Measurement of Orientation
5.6 Rank
5.7 Determinant Product and Inverse Formula
5.8 Determinants, Transposes, and SVD
5.9 Cramer's Rule Revisited
5.10 Determinant Column Formula
5.11 Perpendicular Projections
5.12 Euler Angles
5.13 Rotations about Lines in 3D

6. General Linear Systems
6.1 Square & Non-Square Cases
6.2 Rank of General Matrices
6.3 Solving Linear Systems with Hangerframes
6.4 Over- and Under-Determined Systems
6.5 Inverses, Transposes, and Pseudoinverses
6.6 Column and Row Rank
6.7 Gaussian Elimination: Usually the First Technique You Learn, But Not Here

7. Vector Spaces: 2D, 3D, 4D, 5D, and Beyond
7.1 Spanning Sets
7.2 Bases & Linear Independence
7.3 Subspaces
7.4 Orthonormal Bases
7.5 Gram–Schmidt Process
7.6 Least Square Fit
7.7 Perpendicular Complements of Subspaces
7.8 Null Space and Image Space
7.9 Rank–Nullity Formula
7.10 Projections
7.11 Approximate Solutions

8. Matrix Diagonalization: Eigenvalues and Eigenvectors

8.1	Diagonalization of a Matrix
8.2	Eigenvalues & Eigenvectors
8.3	Exponential of a Matrix
8.4	Dynamical Systems
8.5	Trace, Determinant
8.6	SVD Analysis & Eigenvalue Decomposition Connection via Transposes