A	**Course Title & Number**	ADVANCED LINEAR ALGEBRA: MTH 512
B	**Pre/Co-requisite(s)**	Admission to MSMTH program
C	**Number of credits**	3
D	**Faculty Name**	Ayman Badawi
E	**Term/ Year**	Fall 2019

G **Instructor Information**

Instructor	Office	Telephone	Email
Ayman Badawi	NAB 262	06 515 2573	abadawi@aus.edu

Office Hours: By appointment

H **Course Description from Catalog**

Topics include the proof-based theory of matrices, determinants, vector spaces, linear spaces, linear transformations and their matrix representations, linear systems, linear operators, eigenvalues and eigenvectors, invariant subspaces of operators, spectral decompositions, functions of operators, and applications to science, industry, and business.

I **Course Learning Outcomes**

Upon completion of the course, students will be able to:

1. Write proofs for simple questions.
2. Demonstrate an understanding of vector spaces, subspaces and change of basis.
3. Solve and analyze matrices using eigenvalues and eigenvectors.
4. Demonstrate an understanding of canonical forms and Jordan forms.
5. Demonstrate an understanding of inner-product spaces, norms, orthonormal bases, operators on inner-product space.
6. Demonstrate an understanding of spectral theory, singular value decomposition and applications of linear algebra.
7. Apply skills learned in linear algebra, for example Least Square Method.

J **Textbook and other Instructional Material and Resources**

MAIN: Class notes. Materials on I-learn and my personal webpage
http://ayman-badawi.com/MTH%20512.html

Secondary: Sheldon Axler, *Linear Algebra Done Right, 1997(any Edition will do)*. The book is available on the web as free download. Any E-text book treats the above concepts will do.

K **Teaching and Learning Methodologies**

The teaching and learning tools used in this course to deliver the subject matter include black board with chocks (if available) but the current white board and markers will do, formal lectures, class discussions.

L **Grading Scale, Grading Distribution, and Due Dates**

Grading Scale

Excellent	
A	Equals 4.00 grade points
Meet Expectation	
A-	Equals 3.80 grade points
B+	Equals 3.30 grade points
B	Equals 3.00 grade points

		<table><tr><td colspan="2">Below Expectation</td></tr><tr><td>B-</td><td>Equals 2.70 grade points</td></tr><tr><td>C+</td><td>Equals 2.30 grade point</td></tr><tr><td>C</td><td>Equals 2.00 grade point</td></tr><tr><td colspan="2">Fail</td></tr><tr><td>F</td><td>Equals 0.00 grade points</td></tr><tr><td colspan="2">Academic Integrity Violation Fail</td></tr><tr><td>XF</td><td>Equals 0.00 grade points</td></tr><tr><td colspan="2">Withdrawal Fail</td></tr><tr><td>WF</td><td>Equals 0.00 grade points</td></tr></table> **Grading Distribution** <table><tr><th>Assessment</th><th>Weight</th><th>Date</th></tr><tr><td>Homework</td><td>15 %</td><td></td></tr><tr><td>Exam 1</td><td>25 %</td><td></td></tr><tr><td>Exam 2</td><td>25 %</td><td></td></tr><tr><td>Final Exam</td><td>35 %</td><td></td></tr><tr><td>Total</td><td>100 %</td><td></td></tr></table>
M	**Explanation of Assessments**	Exams, homework assignments will include simple proofs. So students are expected to master some of the techniques that are commonly used in linear algebra.
N	**Student Academic Integrity Code Statement**	Student must adhere to the Academic Integrity code stated in the graduate catalog.

SCHEDULE (BUT NOT IN ORDER)

No addendum, make-up exams, or extra assignments to improve grades will be given.

#	WEEK	CHAPTER/SECTIONS	NOTES
1	1	**Vector Spaces**	Definition Examples
2	2	**Subspaces and Direct Sums**	Definition Examples Proofs of some simple results

4	2	**Span, Linear Independence, Bases, Dimension , and Linear Transformation**	Examples Proofs of some simple results
6	1	**Exam 1**	
7	2	**Eigenvalues, Eigenvectors, and Invariant Subspaces on Real Vector Spaces**	Examples Using the methods in analyzing some basic facts on matrices
9	2	**Inner Products, Orthonormal Bases, Orthogonal Projections and Minimization Problems (Least Square Method)**	Definition Examples Simple proofs Application
11	1	**Operators on Inner-Product Spaces**	Examples Simple and Basic Proofs
12	1	**Exam 2**	Exam 2 : Covers all materials after Exam 1
13	1	**The Characteristic polynomial and the minimal polynomial of an operator, and its decomposition**	Examples Simple Proofs
14	1	**Canonical forms, Rational and Jordan Forms**	Definition Examples

15	1	**Spectral theory, Singular Value Decomposition**	Examples
16	1	**Review before a comprehensive final exam**	