Washtenaw Community College Comprehensive Report

MTH 197 Linear Algebra
Effective Term: Spring/Summer 2024

Course Cover

College: Math, Science and Engineering Tech
Division: Math, Science and Engineering Tech
Department: Math & Engineering Studies
Discipline: Mathematics
Course Number: 197
Org Number: 12200
Full Course Title: Linear Algebra
Transcript Title: Linear Algebra
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Course description
Outcomes/Assessment
Rationale: Course is due for syllabus review after CAR which has just been submitted.
Proposed Start Semester: Winter 2024
Course Description: In this course, students will be introduced to linear algebra. Topics include proof techniques, systems of linear equations, matrix algebra, vector spaces including abstract spaces like Pn, linear independence and span, bases and dimension, and linear transformations with their matrices. Additionally, students will explore rank theorems, isomorphism, eigenvalues and eigenspaces, diagonalization, inner product spaces, orthogonal matrices, Gram-Schmidt orthogonalization, along with various applications such as least squares approximation and QR factorization.

Course Credit Hours

Variable hours: No
Credits: 4
Lecture Hours: Instructor: 60 **Student:** 60
Lab: Instructor: 0 **Student:** 0
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 60 **Student:** 60
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Level 7

Requisites

Prerequisite

MTH 192 minimum grade "C"

General Education

Degree Attributes

Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math

Michigan Transfer Agreement - MTA

MTA Mathematics

Request Course Transfer

Proposed For:

Eastern Michigan University
Ferris State University
Grand Valley State University
Jackson Community College
Lawrence Tech
Michigan State University
Oakland University
University of Detroit - Mercy
University of Michigan
Wayne State University
Western Michigan University

Student Learning Outcomes

1. Solve systems of linear equations and find the Least Squares approximation when the solution set is empty.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average on questions for each outcome
   Who will score and analyze the data: Department faculty

2. Perform standard computations including determinants, matrix inverses, eigenvalues and eigenvectors, and Gram-Schmidt orthogonalization.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric

Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
Who will score and analyze the data: Department faculty

3. Apply the fundamental theorems of linear transformations on vector spaces.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

4. Apply the basic theorems of inner product spaces.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

5. Apply and interpret the theorems and applications of eigenvalues and eigenspaces, as well as their relationships to linear transformations.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

6. Solve common application problems like Markov Chains, QR factorization, and others.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2026
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections for which data are available
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally developed rubric.

Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
Who will score and analyze the data: Department faculty

Course Objectives

1. Translate from a system of linear equations to a vector equation.
2. Translate from a system of linear equations to a matrix equation.
3. Solve a system of linear equations by row-reducing the coefficient matrix.
4. Calculate the parametric form of the solution of a system of linear equations.
5. Determine if a matrix is invertible or not.
6. Compute the inverse of an invertible matrix.
7. Compute the determinant of an n-by-n matrix.
8. Apply the Invertible Matrix Theorem to answer questions about the column space, null space, rank, and the transformation x -> Ax, for a given matrix A.
9. Determine if a given subset of a vector space is a subspace.
10. Find a basis for a subspace.
11. Determine if a linear transformation is one-to-one and onto.
12. Identify the null space, column space, and rank of a matrix.
13. Identify the kernel and range of a linear transformation.
14. Determine if a set of vectors is orthogonal.
15. Construct a set of orthogonal vectors using the Gram-Schmidt algorithm.
16. Find an orthogonal basis for a subspace.
17. Calculate the orthogonal projection of a vector onto a subspace.
18. Calculate the characteristic equation of an n-by-n matrix.
19. Calculate the eigenvectors and associated eigenspaces of an n-by-n matrix.
20. Diagonalize an n-by-n matrix.
21. Orthogonally diagonalize a symmetric matrix.
22. Identify the rotation and scaling associated with the complex eigenvalues of a 2-by-2 matrix.
23. Solve the Normal Equations to find the least-squares solution to an inconsistent system of linear equations.
24. Determine if a QR factorization of a matrix exists, and if so, compute it.
25. Determine if a unique least-squares solution exists for a given system of linear equations, and if so, use the QR factorization to compute the solution.

New Resources for Course

Course Textbooks/Resources

Textbooks

Lay, D., Lay, S., McDonald, J. *Linear Algebra and Its Applications*, 6 ed. Pearson, 2016, ISBN: 0-321-98261-4.

Beezer, R, A. *A First Course in Linear Algebra*, 3.50 ed. Robert Beezer, 2017, ISBN: NA.

Manuals
Periodicals
Software

Equipment/Facilities

Level I classroom

Reviewer	Action	Date
Faculty Preparer:		
Lawrence David	*Faculty Preparer*	*Aug 25, 2023*
Department Chair/Area Director:		
Nichole Klemmer	*Recommend Approval*	*Sep 19, 2023*

Dean:		
Tracy Schwab	*Recommend Approval*	*Sep 21, 2023*
Curriculum Committee Chair:		
Randy Van Wagnen	*Recommend Approval*	*Mar 09, 2024*
Assessment Committee Chair:		
Jessica Hale	*Recommend Approval*	*Mar 13, 2024*
Vice President for Instruction:		
Brandon Tucker	*Approve*	*Mar 15, 2024*

Washtenaw Community College Comprehensive Report

MTH 197 Linear Algebra
Effective Term: Spring/Summer 2022

Course Cover

College: Math, Science and Engineering Tech
Division: Math, Science and Engineering Tech
Department: Math & Engineering Studies
Discipline: Mathematics
Course Number: 197
Org Number: 12200
Full Course Title: Linear Algebra
Transcript Title: Linear Algebra
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Course description
Pre-requisite, co-requisite, or enrollment restrictions
Outcomes/Assessment
Rationale: Standard syllabus review and update. The requested prerequisite change is a mathematical maturity requirement. Most universities to which the course transfers have a Calc 2 prerequisite or higher. For example the University of Michigan has a Calc 2 prereq for Math 214 and Calc 3 for Math 217. MTH 197 is somewhere between 214 and 217 in terms of content and difficulty, so a Calc 2 prerequisite seems more appropriate than Calc 1.
Proposed Start Semester: Winter 2022
Course Description: This is an introductory course in linear algebra, with proofs. Topics include proof techniques, systems of linear equations, matrix algebra, vector spaces including abstract spaces like Pn, linear independence and span, bases and dimension, linear transformations and their matrices, rank theorems, isomorphism, eigenvalues and eigenspaces, diagonalization, inner product spaces, orthogonal matrices, Gram-Schmidt orthogonalization, and various applications including least squares approximation and QR factorization.

Course Credit Hours

Variable hours: No
Credits: 4
Lecture Hours: Instructor: 60 **Student:** 60
Lab: Instructor: 0 **Student:** 0
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 60 **Student:** 60
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Level 7

Requisites

Prerequisite

Academic Math Level 7

or

Prerequisite

MTH 192 minimum grade "C"

General Education

Degree Attributes

Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math

Michigan Transfer Agreement - MTA

MTA Mathematics

Request Course Transfer

Proposed For:

Eastern Michigan University
Ferris State University
Grand Valley State University
Jackson Community College
Lawrence Tech
Michigan State University
Oakland University
University of Detroit - Mercy
University of Michigan
Wayne State University
Western Michigan University

Student Learning Outcomes

1. Solve systems of linear equations and interpret those solutions in applications.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average on questions for each outcome
   Who will score and analyze the data: Department faculty

2. Perform standard computations including determinants, matrix inverses, eigenvalues and eigenvectors, and Gram-Schmidt orthogonalization.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023

Assessment Cycle: Every Two Years
Course section(s)/other population: All sections
Number students to be assessed: All students in each section, or a stratified sample of at least 100
How the assessment will be scored: Departmentally-developed rubric
Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
Who will score and analyze the data: Department faculty

3. Apply the fundamental theorems of linear transformations on vector spaces.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

4. Apply the basic theorems of inner product spaces.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

5. Apply and interpret the theorems and applications of eigenvalues and eigenspaces, as well as their relationships to linear transformations.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students in each section, or a stratified sample of at least 100
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
   Who will score and analyze the data: Department faculty

6. Solve common application problems like least squares approximation, Markov Chains, QR factorization, and others.
   Assessment 1
   Assessment Tool: Outcome-related common departmental final exam questions
   Assessment Date: Spring/Summer 2023

Assessment Cycle: Every Two Years
Course section(s)/other population: All sections for which data are available
Number students to be assessed: All students in each section, or a stratified sample of at least 100
How the assessment will be scored: Departmentally developed rubric.
Standard of success to be used for this assessment: 75% of students will score 75% or higher on average, on questions for each outcome
Who will score and analyze the data: Department faculty

Course Objectives

1. Translate from a system of linear equations to a vector equation.
2. Translate from a system of linear equations to a matrix equation.
3. Solve a system of linear equations by row-reducing the coefficient matrix.
4. Calculate the parametric form of the solution of a system of linear equations.
5. Determine if a matrix is invertible or not.
6. Compute the inverse of an invertible matrix.
7. Compute the determinant of an n-by-n matrix.
8. Apply the Invertible Matrix Theorem to answer questions about the column space, null space, rank, and the transformation x -> Ax, for a given matrix A.
9. Determine if a given subset of a vector space is a subspace.
10. Find a basis for a subspace.
11. Determine if a linear transformation is one-to-one and onto.
12. Identify the null space, column space, and rank of a matrix.
13. Identify the kernel and range of a linear transformation.
14. Determine if a set of vectors is orthogonal.
15. Construct a set of orthogonal vectors using the Gram-Schmidt algorithm.
16. Find an orthogonal basis for a subspace.
17. Calculate the orthogonal projection of a vector onto a subspace.
18. Calculate the characteristic equation of an n-by-n matrix.
19. Calculate the eigenvectors and associated eigenspaces of an n-by-n matrix.
20. Diagonalize an n-by-n matrix.
21. Orthogonally diagonalize a symmetric matrix.
22. Identify the rotation and scaling associated with the complex eigenvalues of a 2-by-2 matrix.
23. Solve the Normal Equations to find the least-squares solution to an inconsistent system of linear equations.
24. Determine if a QR factorization of a matrix exists, and if so, compute it.
25. Determine if a unique least-squares solution exists for a given system of linear equations, and if so, use the QR factorization to compute the solution.

New Resources for Course

Course Textbooks/Resources

Textbooks

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Beezer, R, A. *A First Course in Linear Algebra*, 3.50 ed. Robert Beezer, 2017, ISBN: NA.

Manuals
Periodicals
Software

Equipment/Facilities

Reviewer	Action	Date
Faculty Preparer:		

Lawrence David	*Faculty Preparer*	*Aug 24, 2021*
Department Chair/Area Director:		
Lawrence David	*Recommend Approval*	*Aug 27, 2021*
Dean:		
Victor Vega	*Recommend Approval*	*Aug 31, 2021*
Curriculum Committee Chair:		
Randy Van Wagnen	*Recommend Approval*	*Dec 07, 2021*
Assessment Committee Chair:		
Shawn Deron	*Recommend Approval*	*Dec 08, 2021*
Vice President for Instruction:		
Kimberly Hurns	*Approve*	*Dec 08, 2021*

Washtenaw Community College Comprehensive Report

MTH 197 Linear Algebra
Effective Term: Winter 2018

Course Cover

Division: Math, Science and Engineering Tech
Department: Mathematics
Discipline: Mathematics
Course Number: 197
Org Number: 12200
Full Course Title: Linear Algebra
Transcript Title: Linear Algebra
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Course description
Pre-requisite, co-requisite, or enrollment restrictions
Outcomes/Assessment
Objectives/Evaluation
Rationale: Update as a result of an assessment report.
Proposed Start Semester: Winter 2018
Course Description: This is a first course in linear algebra. Topics include systems of linear equations, vector equations and matrix equations; matrix algebra, partitions and factorizations; determinants; matrix inverses and the Invertible Matrix Theorem; vector spaces and subspaces; linear independence, bases and dimension; null and column spaces, rank; linear transformations on vector spaces, kernel and range; injective, surjective and bijective mappings; isomorphism; eigenvalues and eigenspaces; diagonalization; inner product spaces, orthogonal matrices, Gram-Schmidt orthogonalization; least-squares approximation; and diagonalization of symmetric matrices.

Course Credit Hours

Variable hours: No
Credits: 4
Lecture Hours: Instructor: 60 **Student:** 60
Lab: Instructor: 0 **Student:** 0
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 60 **Student:** 60
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Level 7

Requisites

Prerequisite
Academic Math Level 7
or
Prerequisite
MTH 191 minimum grade "C"

General Education

Degree Attributes
Assoc in Applied Sci - Area 3
Assoc in Science - Area 3
Assoc in Arts - Area 3
MACRAO Science & Math
Michigan Transfer Agreement - MTA
MTA Mathematics

Request Course Transfer

Proposed For:
Central Michigan University
Eastern Michigan University
Ferris State University
Grand Valley State University
Jackson Community College
Lawrence Tech
Michigan State University
Oakland University
University of Detroit - Mercy
University of Michigan
Wayne State University
Western Michigan University

Student Learning Outcomes

1. Solve systems of linear equations.
   Assessment 1
   Assessment Tool: Common departmental exam questions
   Assessment Date: Spring/Summer 2019
   Assessment Cycle: Every Two Years
   Course section(s)/other population: All sections
   Number students to be assessed: All students
   How the assessment will be scored: Department rubric
   Standard of success to be used for this assessment: 75% of students will score 75% or better
   Who will score and analyze the data: Departmental faculty

2. Compute determinants and inverses of matrices.
   Assessment 1
   Assessment Tool: Common departmental exam questions
   Assessment Date: Spring/Summer 2019
   Assessment Cycle: Every Two Years

Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Department rubric
Standard of success to be used for this assessment: 75% of students will score 75% or better
Who will score and analyze the data: Departmental faculty

3. Apply the fundamental theorems of linear transformations on vector spaces.
Assessment 1
Assessment Tool: Common departmental exam questions
Assessment Date: Spring/Summer 2019
Assessment Cycle: Every Two Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Department rubric
Standard of success to be used for this assessment: 75% of students will score 75% or better
Who will score and analyze the data: Departmental faculty

4. Apply the basic theorems of inner product spaces.
Assessment 1
Assessment Tool: Common departmental exam questions
Assessment Date: Spring/Summer 2019
Assessment Cycle: Every Two Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Department rubric
Standard of success to be used for this assessment: 75% of students will score 75% or better
Who will score and analyze the data: Departmental faculty

5. Compute eigenvalues and eigenvectors and use them in applications.
Assessment 1
Assessment Tool: Common departmental exam questions
Assessment Date: Spring/Summer 2019
Assessment Cycle: Every Two Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Department rubric
Standard of success to be used for this assessment: 75% of students will score 75% or better
Who will score and analyze the data: Departmental faculty

6. Calculate the least-squares solution to a system of linear equations.
Assessment 1
Assessment Tool: Common departmental exam questions
Assessment Date: Spring/Summer 2019
Assessment Cycle: Every Two Years
Course section(s)/other population: All sections
Number students to be assessed: All students
How the assessment will be scored: Department rubric
Standard of success to be used for this assessment: 75% of students will score 75% or better
Who will score and analyze the data: Departmental faculty

Course Objectives

1. Translate from a system of linear equations to a vector equation.
2. Translate from a system of linear equations to a matrix equation.

3. Solve a system of linear equations by row-reducing the coefficient matrix.
4. Calculate the parametric form of the solution of a system of linear equations.
5. Determine if a matrix is invertible or not.
6. Compute the inverse of an invertible matrix.
7. Compute the determinant of an n-by-n matrix.
8. Apply the Invertible Matrix Theorem to answer questions about the column space, null space, rank, and the transformation x -> Ax, for a given matrix A.
9. Determine if a given subset of a vector space is a subspace.
10. Find a basis for a subspace.
11. Determine if a linear transformation is one-to-one and onto.
12. Identify the null space, column space, and rank of a matrix.
13. Identify the kernel and range of a linear transformation.
14. Determine if a set of vectors is orthogonal.
15. Construct a set of orthogonal vectors using the Gram-Schmidt algorithm.
16. Find an orthogonal basis for a subspace.
17. Calculate the orthogonal projection of a vector onto a subspace.
18. Calculate the characteristic equation of an n-by-n matrix.
19. Calculate the eigenvectors and associated eigenspaces of an n-by-n matrix.
20. Diagonalize an n-by-n matrix.
21. Orthogonally diagonalize a symmetric matrix.
22. Identify the rotation and scaling associated with the complex eigenvalues of a 2-by-2 matrix.
23. Solve the Normal Equations to find the least-squares solution to an inconsistent system of linear equations.
24. Determine if a QR factorization of a matrix exists, and if so, compute it.
25. Determine if a unique least-squares solution exists for a given system of linear equations, and if so, use the QR factorization to compute the solution.

New Resources for Course

Course Textbooks/Resources

Textbooks

Lay, D., Lay, S., McDonald, J. *Linear Algebra and Its Applications*, 5 ed. Pearson, 2016, ISBN: 0-321-98261-4.

Manuals

Periodicals

Software

Equipment/Facilities

Reviewer	Action	Date
Faculty Preparer:		
Lawrence David	*Faculty Preparer*	*Aug 21, 2017*
Department Chair/Area Director:		
Lisa Rombes	*Recommend Approval*	*Aug 21, 2017*
Dean:		
Kristin Good	*Recommend Approval*	*Aug 23, 2017*
Curriculum Committee Chair:		
Lisa Veasey	*Recommend Approval*	*Oct 23, 2017*
Assessment Committee Chair:		

Michelle Garey	*Recommend Approval*	*Oct 24, 2017*
Vice President for Instruction:		
Kimberly Hurns	*Approve*	*Oct 25, 2017*