Course Title: Intro Linear Algebra
Course Number: MATH 235
Instructor, Office, Email: Eric Sarfo Amponsah (He/Him/His), esarfoampons@umass.edu, flexible office hours (details on Canvas). If I do not reply to your email in less than 3 hours, please send a follow-up.

Remote learning: (Hybrid – asynchronous with some optional live sessions). All lecture videos will be posted on Canvas. There will be live discussions/problem-solving sessions by your TAs. They will discuss problems from textbook/worksheets and take general questions. Live sessions will be TTH 11:00am -12:00pm ET. Live sessions are optional to attend and will be recorded.

Prerequisites: Math 132 or consent of the instructor. (Gen.Ed. R2)

Course Description: Math 235 is an introductory course on linear algebra, covering systems of linear equations, matrix algebra, linear transformations, determinants, vector spaces, eigenvalues and eigenvectors, orthogonality, and the Gram-Schmidt process. We will also explore some few applications including polynomial curve fitting, networks, and discrete dynamical systems (Markov chains).

Number of course credits: 3. Note: 1 credit is equivalent to an average of 3 hours of work per week.

Learning Objectives:
Upon completion of this course, the successful student will be able to:
1. Use Gaussian elimination to do all the following: solve a linear system with reduced row echelon form, solve a linear system with row echelon form and backward substitution, find the inverse of a given matrix, and find the determinant of a given matrix.
2. Demonstrate proficiency in matrix algebra. For matrix multiplication, demonstrate understanding of the associative law, the reverse order law for inverses and transposes, and the failure of the commutative law and the cancellation law.
3. Use Cramer's rule to solve a linear system.
4. Use cofactors to find the inverse of a given matrix and the determinant of a given matrix.
5. Determine whether a set with a given notion of addition and scalar multiplication is a vector space.
6. Determine whether a given subset of a vector space is a subspace.
7. Determine whether a given set of vectors is linearly independent, spans, or is a basis.
8. Determine the dimension of a given vector space or of a given subspace.
9. Find bases for the null space, row space, and column space of a given matrix, and determine its rank.
10. Demonstrate understanding of the Rank-Nullity Theorem and its applications.
11. Given a description of a linear transformation, find its matrix representation relative to given bases.
12. Demonstrate understanding of the relationship between similarity and change of basis.
13. Find the norm of a vector and the angle between two vectors in an inner product space.
14. Use the inner product to express a vector in an inner product space as a linear combination of an orthogonal set of vectors.
15. Find the orthogonal complement of a given subspace.
16. Demonstrate understanding of the relationship of the row space, column space, and null space of a matrix (and its transpose) via orthogonal complements.
17. Demonstrate understanding of the Cauchy-Schwartz inequality and its applications.
18. Determine whether a vector space with a given form is an inner product space.
19. Use the Gram-Schmidt process to find an orthonormal basis of an inner product space. Be capable of doing this both in \( \mathbb{R}^n \) and in function spaces that are inner product spaces.
20. Find orthogonal projections onto subspaces.
21. Find (real and complex) eigenvalues and eigenvectors of \( 2 \times 2 \) or \( 3 \times 3 \) matrices.
22. Determine whether a given matrix is diagonalizable. If so, find a matrix that diagonalizes it via similarity.
23. Demonstrate understanding of the relationship between eigenvalues of a square matrix and its determinant, its trace, and its invertibility/singularity.
24. Use the concepts of linear systems for polynomial curve fitting.
25. Correctly define terms and give examples relating to the above concepts.
26. Be familiar with basic theorems about the above concepts.
27. Prove or disprove statements relating to the above concepts.
28. Be adept at hand computation for row reduction, matrix inversion and similar problems.

**Process Learning Outcomes:**
- Students will be able to understand linear algebra problems from three perspectives of analysis, algebra, and geometry.
- Students will be able to appropriately apply linear algebra methods.
- Students will improve their technical reading and writing skills in the context of linear algebra.

**Text** - Linear Algebra and its Applications (6th edition) by David Lay, Steven Lay & Judi McDonald.

*MyMathLab* is required for this course. An electronic copy of the textbook is included in your purchase of MyMathLab. Online homework and quizzes will be assigned through MyMathLab. You can enroll on MyMathLab using the tool link on Canvas. **Everyone has free access for 14 days and can register for temporary access before the add/drop date, so enroll immediately for free.**

**Course Requirements:** Students enrolled in this course are required to

- Watch all recorded lectures.
- participate in class discussion forums on Canvas.
- Attend live discussion sessions (or watch the recorded videos).
- complete homework assignments and quizzes in a timely manner. (To receive a passing grade, students must complete at least 60% of homework and quizzes)
- Take the midterm exam and final exam (to receive a passing grade, students must at least 50% in the exam category).
Week-by-week breakdown of assignments/topics/exams, events:
(Tentative Schedule – WILL be adjusted – See full course schedule in the class guide)
Week 1 Chapter 1
Week 2 Chapter 2
Week 3 Chapter 3---Midterm
Week 4 Chapter 4
Week 5 Chapter 5
Week 6 Chapter 6---Final Exam

Assessments: Students must complete all assignments as described below

<table>
<thead>
<tr>
<th>Course Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Exam 1</td>
<td>30%</td>
</tr>
<tr>
<td>Exam 2</td>
<td>30%</td>
</tr>
<tr>
<td>MyMathLab Homework</td>
<td>30%</td>
</tr>
<tr>
<td>MyMathLab Quiz</td>
<td>10%</td>
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</tbody>
</table>

To receive a passing grade, students must complete each exam and achieve a combined average of 50%.

Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>A</th>
<th>A-</th>
<th>B+</th>
<th>B</th>
<th>B-</th>
<th>C+</th>
<th>C</th>
<th>C-</th>
<th>D+</th>
<th>D</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>90</td>
<td>87</td>
<td>83</td>
<td>79</td>
<td>75</td>
<td>71</td>
<td>67</td>
<td>63</td>
<td>59</td>
<td>55</td>
<td>&lt;55</td>
</tr>
</tbody>
</table>

There is no rounding of grades in this course. For example, an 89.99999 is an A- and not an A.

Calculator: Calculators will not be allowed in the exams. You may use calculators to check your homework solutions, but credit will be given only for answers showing all your steps (unless mentioned otherwise in the assignment).

MyMathLab Assignments: There will be 28 homework assignments and 28 quizzes on MyMathLab (one from each section). You will have 8 attempts for homework problems and only one attempt for quizzes. Students must complete the assignments within the week they are taught in accordance with the course schedule. Students who miss deadlines for MyMathLab assignments can attempt them for 50% credit.

Exams: There will be one midterm and a final exam. All exams will be through Canvas; however, the exam will be uploaded onto gradescope for grading. Exams are proctored by Honorlock. All exams are closed book; however, you will be allowed a single paper note sheet. Paper size should not exceed A4 size and notes MUST be handwritten (not printed). To receive a passing grade, students must receive at least 50% in the exam category.

Make-up Policy: Students who are absent due to excusable extenuating circumstances remain responsible for meeting all class requirements and contacting me in a timely fashion about making up missed work. The following are acceptable reasons for missing an exam:

Exam/Class Conflict: Exams will have a flexible time range to avoid conflicts. Typically, exams will be open 6:00am to 6:00pm ET (the day of the exam). Students should plan to take the exam at a time that works best for them within this range. Each exam is 2 hours long.
Religious Observance: You should contact your instructor at the beginning of the semester if you must miss an exam due to religious observance.

Medical Reasons: If you will be absent from an exam due to medical reasons, you should notify your instructor at least one week in advance of the exam. If you have a medical emergency, you should notify your instructor as soon as possible. In either case, you may need to provide documentation. You need not disclose any details of the reason for a medical excuse, but there must be enough information to allow the absence to be excused.

Other Circumstances: It is impossible to anticipate all of the possible things that can occur. In case of an exceptional event beyond those covered above, contact your instructor and explain the problem. (You should be prepared to provide a written statement if necessary.) Your instructor will evaluate the reasons that you have given and come to a decision.

Note that there is no re-taking of exams in this course. So, if you are sick and take the exam anyway, you cannot re-take the exam later for a better grade. Regardless of the situation, if you do not feel you can take the exam on the scheduled date notify your instructor immediately. Once you take the exam, there is nothing that can be done to change the grade.

Make-up exams will not be given to accommodate travel plans.

Electronic Submission: In case an online platform is utilized, it is your responsibility to make sure any electronic submission goes through successfully (uploaded, no blurry images, and the questions and answers match) and check with your instructor or TA that the submission is successful. You should make sure you submit your exams on gradescope before the exam time runs out.

Accommodation Statement: The University of Massachusetts Amherst is committed to making reasonable, effective and appropriate accommodations to meet the needs of students with disabilities and help create a barrier-free campus. If you have a disability and require accommodations, please register with Disability Services (161 Whitmore Administration building; phone 413-545-0892), meet with an Access Coordinator and send an accommodation letter to your faculty. Information on services and materials for registering are also available on the website [www.umass.edu/disability](http://www.umass.edu/disability)

Academic Honesty Statement
Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students
are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

**Chegg, Discord, ChatGPT and other online help resources:** Seeking answers from any website is a clear violation of the academic honesty policy, while submitting course materials to these sites or similar ones is a violation of the instructor’s copyright. Instructors may be monitoring such websites throughout the semester.

Do not use AI tools such as ChatGPT to complete the homework. If you are stuck, you have several other options:
- Ask instructor, TA or fellow student using the discussion forum.
- Go to live sessions and office hours.
- Send an email to the instructor.
- Review the content in the textbook.

**Title IX Statement**
In accordance with Title IX of the Education Amendments of 1972 that prohibits gender-based discrimination in educational settings that receive federal funds, the University of Massachusetts Amherst is committed to providing a safe learning environment for all students, free from all forms of discrimination, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and retaliation. This includes interactions in person or online through digital platforms and social media. Title IX also protects against discrimination on the basis of pregnancy, childbirth, false pregnancy, miscarriage, abortion, or related conditions, including recovery. There are resources here on campus to support you. A summary of the available Title IX resources (confidential and non-confidential) can be found at the following link: https://www.umass.edu/titleix/resources. You do not need to make a formal report to access them. If you need immediate support, you are not alone. Free and confidential support is available 24 hours a day / 7 days a week / 365 days a year at the SASA Hotline 413-545-0800.