Kennesaw State University
College of Science and Mathematics
Department of Mathematics
Fall Semester 2025
MATH 4260 (Section 51): Linear Algebra II

Contents

1. (Un)popular Answers to Popular Questions

1. *What is happening when? When are things due?* See the contact information in Section 2 and the calendar in Section 8.

2. *What is my grade?* See the formula at the start of Section 5. Your grades are on D2L.

3. *What and where are the course materials?* See Section 4. Your grades and solutions to exams are password-protected on D2L. Everything else (such as the daily log, problem sets, and exam information documents) is on the course website.

4. *How should I write an email to you?* See Section 6.3. I appreciate salutations.

5. *How should I be using my time?* See Section 6.5 for a workload breakdown.

6. *I can't come to class today. What should I do?* Read, when posted, the daily log line by line (see Section 6.5 for reading guidelines); email questions and visit during office hours to discuss specific topics that you have studied in advance.

7. *All the notes are online. What's the point of coming to class?* Focus and interaction. Being in class lets you *focus* specifically on course material and *interact* with me and your classmates. Low attendance typically correlates to low grades.

8. *Can I turn in a problem set late?* Possibly. See Section 5.2 for the policy on pushing a problem set back.

9. *Why are you being so picky with the formatting of the problem sets and that "complete sentence" requirement?* For your benefit and for mine: to make your work easier for you to reread later in the future and for me to parse for credit, and so that you can continue to grow into the strongest writer and expositor possible. See also Section 5.2.1.

10. *What's up with the deadlines for problem sets vs. quiz dates?* Problem sets are due on Wednesday nights and quizzes (based strictly on the problem sets) are on Friday mornings. The goal is that you have all of the problems done for a quiz well in advance of that quiz and that you have Thursday to clean up any last-minute misunderstandings.

11. *Can I make up a vocabulary quiz or exam?* Maybe for the quiz, quite possibly for the exam. See Sections 5.3 and 5.4 for the procedures and policies regarding make-ups.

12. *I don't understand what we're doing, and everything feels awful. How can things get better?* First, remember that no feeling lasts forever; second, don't make major decisions when you're feeling crummy. Start by looking at Section 6. Are you coming to class? Talking with me? Putting in a solid 9 hours of work per week? Absolutely sure that you understand what every single word means and that you can give examples and nonexamples of all concepts? Try to articulate clearly to yourself and then to me how you're living your Math 4260 life, what your Math 4260 goals are, and what precisely is not right with your Math 4260 experience.

2. Contact Information

Instructor: Dr. Timothy Faver
Email: `tfaver1_AT_kennesaw.edu` (this is the best way to contact me)
Website: `https://tefaver.com/teaching/math-4260/`
Class time: MWF 11:15 am–12:05 pm
Class location: Mathematics Room D249
Office: Mathematics Room D248
Office hours: M 10:00 am–11:00 am, W 2:30 pm–3:30 pm

3. Learning Outcomes

Upon successfully completing this course, you will be able to do the following:

1. Identify fundamental structural properties of abstract vector spaces, such as bases, dimension, subspaces, coordinate systems, and change of basis;

2. Evaluate basic properties of linear operators, such as kernel, range, invertibility, composition, adjoints, eigenvalues, and matrix representations;

3. Interpret geometric properties of abstract inner product spaces, such as orthonormal bases, orthogonal complements, projections, norms, and least squares approximations.

4. Use linear algebra concepts to study relevant applications, such as the existence and consequences of the singular value decomposition.

5. Write formal proofs of linear algebra concepts using techniques such as direct proof, contrapositive, contradiction, and induction and concepts from set theory.

Linear algebra is arguably the most important mathematical subject—at least as important, if not more important, than calculus. Linear structures undergird and pervade virtually all of pure and applied mathematics with constant use in physics, chemistry, engineering, and data science. A thorough understanding of linear algebra—theoretical, computational, and applied—will benefit anyone working in nearly any STEM field.

A first course in linear algebra often focuses on vectors and matrices and understanding linear systems compressed as the matrix-vector problem $A\mathbf{x} = \mathbf{b}$. This is a good approach, and it's the way that I like to think of Linear I. However, we can't stop there. Finite-dimensional Euclidean spaces can't contain the whole story, especially for applications to differential equations, which are inherently infinite-dimensional problems.

This course will revisit and refine many concepts from Linear I (indeed, the learning outcomes above may well look quite familiar) with an emphasis on infinite-dimensional vector spaces and the linear operators mapping between them. If Linear I was all about solving $A\mathbf{x} = \mathbf{b}$ (and maybe a little more than that), then Linear II is all about solving $\mathcal{T}v = w$, where $\mathcal{T}\colon \mathcal{V} \to \mathcal{W}$ is a linear operator, $\mathcal{V}$ and $\mathcal{W}$ are vector spaces, and $w \in \mathcal{W}$ is a given vector. When we can solve this problem, we then ask about the uniqueness of the solution v; when we can't, we try to approximate w by some $\widehat{w} \in \mathcal{W}$ for which $\mathcal{T}v = \widehat{w}$ does have a solution. Almost everything that we do will somehow be oriented toward addressing this fundamental problem of linear algebra: how to characterize the range of a linear operator.

4. Course Materials

1. We will follow the book ***Linear Algebra*** by Elizabeth S. Meckes and Mark W. Meckes quite closely, except when we won't, and sometimes we will follow the book rather nonlinearly. The book is intended for a proof-oriented first course in linear algebra, which corresponds nicely to my vision for Linear II at KSU. Some resources from the book, including a glossary (see Section 5.3), are linked on the course website.

2. You may wish to consult your Linear I book throughout the term; virtually any text used for MATH 3260 at KSU will be helpful. A version of my Linear I notes is also on the course website. The books *Linear Algebra Done Right* by Axler, *The Less Is More Linear Algebra of Vector Spaces and Matrices* by Calvetti and Somersalo, *Linear Algebra* by Friedberg, Insel, and Spence, *Linear Algebra Done Wrong* by Treil, and *Advanced Linear Algebra* by Woerdeman contain perspectives that will helpfully complement our own.

3. I will keep a **daily log** for our classes and post it on the course website. The log will contain corresponding reading from the textbook, a detailed (and idiosyncratic) discussion of what we cover in class each day, and a variety of problems, many of which I will assign and most of which you should attempt.

4. Please remove AirPods and other listening devices during class.

5. Grading

Your final numerical grade will be based on weekly problem sets, four in-class vocabulary quizzes, two in-class exams, and a final exam. The following weights will determine your final numerical grade.

Problem Sets	25%
Vocabulary quizzes	15%
Lowest exam score	15%
Middle exam score	20%
Highest exam score	25%

Your final letter grade will be determined by the interval to which your final numerical grade belongs.

Numerical grade	**[90,100]**	**[80,90)**	**[70,80)**	**[60,70)**	**[0,60)**
Letter grade	A	B	C	D	F

5.1. Attendance. *Regular and engaged attendance is essential for your learning; failures in my classes are strongly correlated with low attendance or attendance with weak engagement.* I will take attendance on each of the days that we meet and do not have an exam. While attendance will not count numerically toward your final grade, it is all but impossible to pass the class without regular *and engaged* attendance. If you stop coming to class and do not submit work at some date past the withdrawal deadline, I will score missing work as 0 and compute your final grade from that; it is therefore highly likely that you will fail the class.

5.2. Problem sets (25%). *Regular work on weekly problem sets will strengthen your understanding of concepts and techniques and extend your awareness of course concepts beyond the scope of class meetings. Success in this class will be impossible without diligent, thorough completion of the problem sets.* There will be 12 problem sets assigned on Fridays and due at 11:59 pm on the following Fridays; see the calendar (Section 8).

5.2.1. Preparation of problem sets. You will submit your solutions to the appropriate slot on D2L, and it is your responsibility to ensure that your D2L submissions are correctly formatted and organized according to the submission instructions. The goal of these stringent formatting requirements (to be repeated/expanded in individual assignment instructions) is twofold. First, I want your work to be as easy for you to revisit and parse as possible, and part of that is making sure your work is clearly organized and formatted. Second, I want your work to be easy for to review so that you get appropriate credit and so that I am sure you are doing the work that is meant to strengthen you.

5.2.2. The complete sentence requirement. Beginning with the third problem set, all solutions must be written using complete sentences, unless I explicitly allow otherwise in the problem set instructions. Examples of mathematical writing in complete sentences appear throughout the daily log and the textbook. Solutions that are not written in complete sentences will be scored 0, regardless of their mathematical correctness. We write to explain ourselves to others and to understand ourselves; clear and complete writing will facilitate everyone's understanding of your work.

5.2.3. Collaboration and consultation on problem sets. You are most welcome to consult with me throughout the week about the preparation of your problem sets; see Section 6.2 for advice on office hours and Section 6.3 for email policy. While you are welcome and encouraged to discuss problems with other students, your final work must be your own; you should write the final version of your solutions by yourself, without consulting others.

5.2.4. Grading of problem sets. I will drop your lowest 3 problem set scores, so that the problem set component of your final grade will be the average of your 9 best problem set scores. I will grade some problems for correctness and the rest for completeness. Problems graded for correctness will be scored from 0 to 5 points, with 0 points for no work, 5 points for essentially complete and correct work, and, in general, a 1-point deduction for each serious error. Problems graded for completeness will be scored from 0 to 2 points, with 0 points for no work, 2 points for complete work, and 1 point for work that, in my professional opinion, falls short of completeness. If solutions to the same problem from two or more people are suspiciously similar, I may score that problem 0 among all similar submissions.

5.2.5. The pushback option. You may push back three assignments from their Friday due date until the following Monday. For example, if you wish to push Problem Set 1 back, you would have until Monday, September 1, at 11:59 pm to submit it. You do not need to provide any reason for a pushback. However, you must request a pushback no later than 5 pm on the Thursday before the assignment is due. For example, if you wish to push Problem Set 1 back, you would have until Thursday, August 28, at 5 pm to tell me that you want to do so. The point of this condition is to ensure that you have started your assignment in a timely fashion and have been thinking about it throughout the week; leaving problem sets for Friday afternoons is dangerous and deleterious both for your learning and your peace of

mind. Once you have used your three pushbacks, I will typically not allow any more, outside of exceptional circumstances at my discretion; once you have pushed a problem set back, I will not accept it late beyond the Monday deadline.

5.3. Vocabulary quizzes (15%). *It's hard to do math if you don't know what the words mean, and this is especially true in vocabulary-heavy linear algebra; to motivate and examine your mastery of meanings, you will take four rather intense vocabulary quizzes throughout the term.* We will take the quizzes during the first 20 minutes of class on four Wednesdays; see Section 8 for the precise dates. You will need to have carefully embedded this vocabulary as rapidly accessible "under-the-hood" knowledge to succeed on these quizzes.

5.3.1. Content of quizzes. In the daily log each day I will specify some words, phrases, or concepts whose definitions you must memorize. You should be able to give an example for each and, in some cases, a nonexample. I will ask you for definitions, examples, and, as appropriate, nonexamples. You may find the vocabulary guide on the website helpful for organizing vocabulary. The quizzes will be cumulative: material from any prior point in the term may appear on a quiz.

5.3.2. Grading of quizzes. I will score each problem from 0 to 5 points, with 0 points for no work, 5 points for a complete and unambiguous definition or entirely correct example or nonexample, and, in general, a 1-point deduction for each serious error. I will drop your lowest quiz grade, so your three best quizzes will count as 5% each of your final grade. If you miss a quiz due to absence (other than for a university-approved event), that will be your dropped score; if you miss another quiz, a make-up may be permissible following the same policy as exam make-ups below (see Section 5.4).

5.4. Exams (60%). *Exam preparation will help you connect discrete course topics; completing an exam under time constraints is one way of evaluating your fluency with course material and your intellectual independence.* There will be two in-class exams (Exams 1 and 2) during the term and a cumulative final exam. The final exam will only be given at the university-specified time, which cannot be changed. See the calendar (Section 8).

5.4.1. Exam information documents and reflections. I will provide a detailed study guide at least a week in advance of each exam. You will earn 5 points on each exam from a reflection activity that you will do based on the study guide.

5.4.2. Absences from exams. In order to be excused from an exam, you must (1) notify me before the start of the exam (or as soon after as the circumstances allow) and (2) provide official documentation (a doctor's note, a proof of COVID test, a note from your employer, etc.) excusing your absence in a timely manner. If your absence from an exam is excused, then you will take a make-up exam either before I return graded exams to the class, or, if that is not possible, during the final exam conflict period (see the calendar in Section 8); if your absence is not excused, you will score a 0 on that exam. Valid (and invalid) reasons for missing an exam are, in general, the same as for missing class. In general, I will not permit a make-up if you notify me of your absence *after* the class has taken exam, barring exceptional circumstances that make prior communication absolutely impossible.

In the (hopefully) unlikely event that you first have an excused absence from Exam 1 and later have an excused absence from Exam 2, then you will take a make-up for Exam 2 within

one week of returning to class. Failure to do so will result in a score of 0 on Exam 2. This is to prevent you from having too much work at the end of the term.

5.5. Midterm grades. I will submit midterm grades by October 24 to help you assess your progress in the course. Here is the official policy: *A midterm grade will be assigned by the midterm grade due date identified on the Fall 2025 academic calendar. This midterm grade is for assessing mid-semester performance prior to the last day to withdraw without academic penalty. You may view your midterm grade in Owl Express. Note that only your final grade will be officially recorded on your academic transcript.*

Your midterm numerical grade will be determined by the following breakdown:

$$20\% \text{ vocabulary quizzes} + 40\% \text{ problem sets} + 40\% \text{ Exam 1}.$$

I will not drop any problem sets or quizzes here. Note that the weights here are, overall, quite different from what will determine your final grade; a good midterm grade is not a promise of a good final grade, but a bad midterm grade should serve as a warning that something is amiss in your current approach to the course. Midterm letter grades will follow the numerical correspondence for your final grade.

5.6. Incomplete grades. The catalogue specifies that an "incomplete grade may be awarded only when the student was doing satisfactory work prior to the last two weeks of the semester but for nonacademic reasons beyond the student's control, was unable to meet the full requirements of the course." I define "satisfactory work" to mean that you can obtain a score on your remaining work that will allow you to pass the class.

The catalog subsequently states that a "grade of 'I' must be removed by completing the course requirements within one calendar year from the end of the semester in which the 'I' was originally assigned. In addition, should the student enroll in classes at KSU during the calendar year, the grade of 'I' must be removed by the end of the first semester of enrollment during that calendar year."

If you are awarded an incomplete for this course, it will be to your advantage to complete all remaining work as soon as possible. Based on your circumstances, we will agree on a mutually convenient and appropriate timeline for completing your work. Failure to follow this timeline without a justifiable excuse may result in failing grades for the missed work and possibly the course. Ideally, you would complete all work by the end of January 2026.

6. Strategies for Success and/or Failure

6.1. Attendance and participation. Failures in my classes are strongly correlated with low attendance *or* attendance with minimal engagement; students who both attend class regularly and engage with me in and/or outside class tend to succeed.

6.2. Office hours. During office hours, we can discuss specific examples, problems, or techniques from class, the daily log, or the textbook. More broadly, we can talk about your study habits, time management, and mathematical reading skills. Before coming to office hours, think carefully about what you want to discuss so that we use our time well.

If my office hours conflict with your other classes, we can make an appointment for a different time. If the currently scheduled office hours conflict with the availability of students who most frequently want to see me, I may change the weekly hours to accommodate the

preferences of the majority. If you would like to meet virtually, please let me know in advance, and I will send a Teams link.

6.3. Email communication. You are welcome to email me questions about any aspect of the course at any time. Feel free to send a photo or scan of work and indicate where you're stuck. A short hint from me can make a big difference for you.

I will (typically) respond to email within 24 hours, but I cannot guarantee a response to questions about problem sets or exams late on Thursday evenings. Those final hours before an exam or quiz need to be about perfecting what is already good in you, not about learning it for the first time.

Please observe the following courtesies in writing emails.

1. Please include the words "Math 4260" in the subject of your email. I filter emails and may not respond to your message promptly, or may miss it entirely, without these key words.

2. Please use your "students" email, not D2L email. I will not respond to messages sent from D2L.

3. Please begin your email with a salutation (e.g., "Hi, Dr. Faver") before the body of text; this is simply good manners (and will put me in a good mood, which will be helpful for you). Please also address me by my name ("Dr. Faver," not just "Professor").

6.4. Reading assignments and recommended problems. It is quite likely, and wholly natural, that you will not fully understand the material that we cover in class. Readings from the textbook(s) will offer different perspectives that may be more conducive to your personal engagement with Math 4260. Part of your mathematical education is developing your reading comprehension; be prepared to invest time, and struggle, with the course's *written* materials before seeking outside help or alternate media.

Doing the required problems *alone* probably will not provide you with enough exposure to course material outside of class. In addition, you should attempt a variety of problems from the "Recommended Problems" lists that I provide each week; challenge yourself to do a certain number of these each week along with the problem sets. Recommended problems will also serve as additional, essential practice and review for exams. You should skim the textbook's problems that I don't assign, as well, and attempt some of them as you study.

6.5. Workload breakdown. In general, it is reasonable (and usually necessary) for you to spend about three hours per credit hour outside of class on work for a course. Since our course is 3 credits, you should spend about 9 hours per week on your coursework. Here is a recommended arrangement of your worktimes for this class for weeks when a problem set is due, which will be most weeks.

2–3 hours: *active (re)reading of class notes and the daily log and selections from textbook (see the daily log).* I define "*active* reading" to mean reading each and every word (possibly *aloud*—this always helps me), clarifying any unknown word or phrase, and redoing each calculation or argument with pen and paper. I expect that you will be patching up gaps from class, working through the examples from the textbook (which will typically differ from what we do in class), and embedding vocabulary, examples, and nonexamples into your

memory for vocabulary quizzes. You may find the vocabulary guide on the website helpful for organizing vocabulary.

3–4 hours: *solving the required problems from the weekly problem set.* I expect you to do whatever you need to in order to understand every step of the solution to every problem. This timeframe by no means expects that you are spending 3 to 4 hours in isolated contemplation of the required problems. Indeed, this will be a highly *nonlinear* activity: you should complete the textbook reading for a particular section before attempting the problems required from that section, but then you should return to the selections from the textbook and the daily log (which you have already actively read) corresponding to those problems for ideas and advice. If you are stuck on a required problem, you may also want to attempt a similar-looking recommended problem; often that can give you the key insight for the required work. Of course, you can and should communicate with other people as part of the process of solving the problems, including your classmates and me.

1–2 hours: *writing up your solutions to the weekly problem set for submission.* This really means *rewriting* your initial work. Your initial work on required problems should not, in general, be what you submit to D2L, but by the time that you really understand your solution to a problem, your understanding should be sharp enough that organizing your submitted solution should not be too much of an ordeal.

This scheme will vary from week to week and person to person, but it will be to your benefit to spread these activities out throughout the week. You should have at least 6 hours of work per week, but there will probably be weeks during which you are able to do all of the above without taking 9 hours. Treasure those weeks! Those are good times to patch up your understanding of prior vocabulary (recall that quizzes are cumulative) and sticky points from class or problem sets that you never resolved to your satisfaction. It will be to your benefit to spread these activities out throughout the week.

6.6. How to fail. The following strategies have helped prior students fail my classes.

1. Don't come to class regularly; in particular, show up only for exams.

2. Be physically present but intellectually disengaged in class. Avoid talking with me.

3. Don't do the problem sets or any recommended practice problems.

4. Save all your Math 4260 work for only one day each week, preferably the day before assignments are due.

5. Ask for, but then completely ignore, my advice on improving your course performance.

6. Fail the first exam and make absolutely no changes in your life after that.

7. Wait until the night before a vocabulary quiz to commit definitions to memory and to prepare your personal supply of examples and nonexamples.

8. Think about the course as an obstacle, not an opportunity. Definitely don't look for

beauty, surprises, or things that might fill you with wonder and curiosity.

7. University Policies and Formal Matters

7.1. Federal, BOR and KSU Student Policies. You should be familiar with the policies detailed via the links below, including the academic integrity statement.

`https://www.kennesaw.edu/curriculum-instruction-assessment/academic-program-planning-development/resources/required-syllabus-information.php`

7.2. Course catalogue description.
3 Credit Hours
Prerequisite: MATH 3260
Topics in this course include real vector spaces and their subspaces; inner product spaces, orthogonal subspaces, Gram–Schmidt process; best approximation; eigenvalues and eigenvectors; special matrices; matrices of general transformations, and various applications including matrix functions.

8. Calendar

You are responsible for knowing all of the due dates for assignments and scheduled dates for exams listed below. All submissions to D2L are due at 11:59 pm on the stated day. If class is canceled on the day of an exam, we will take that exam during our next meeting, unless I specify otherwise. If the university cancels class, I may assign some short independent reading and/or eventually prepare a video lecture to make up for the lost time.

F August 29	Problem Set 1 due on D2L
M September 1	No class—Labor Day
F September 5	Problem Set 2 due on D2L
F September 12	Problem Set 3 due on D2L
W September 17	Vocabulary Quiz 1 in class
F September 19	Problem Set 4
Sa September 20	Exam 1 reflection due on D2L
F September 26	Exam 1 in class
F October 3	Problem Set 5 due on D2L
W October 8	Vocabulary Quiz 2 in class
F October 10	Problem Set 6 due on D2L
F October 17	Problem Set 7 due on D2L
F October 24	Problem Set 8 due on D2L
M October 27	Exam 2 reflection due on D2L
F October 31	Exam 2 in class
F November 7	Problem Set 9 due on D2L
W November 12	Vocabulary Quiz 3 in class
F November 14	Problem Set 10 due on D2L
F November 21	Problem Set 11 due on D2L
M–F November 24–28	No class—Thanksgiving break
W December 3	Vocabulary Quiz 4 in class
F December 5	Problem Set 12
Sa December 6	Final Exam reflection due on D2L
T December 9	Exam makeups 3:30 pm–4:30 pm
W December 10	Final exam 10:30 am–12:00 pm