

Mathematics 203 – 008; Linear Algebra; Fall 2021 (CRN 82933)

Class Schedule: Mon & Wed: 7:20 – 8:35 PM	Location: Horizon Hall 1014
Class Dates: Mon 23 Aug – Wed 1 Dec	Final exam: Wed 8 Dec 7:30 – 10:15 PM In Classroom
Instructor: Mr. Glenn Preston	Email: gpresto3@gmu.edu
Office: Exploratory Hall 4309	Office Hours: Mon & Wed 3:30 – 5:30 PM and by appt.

PREREQUISITES:

- Grade of C or higher in Math 114, 114T, or 116 → In addition you will need to have a **SOLID** foundation in geometry, **algebra**, functions in the xy-plane, and be proficient in basic arithmetic

REQUIRED TEXTBOOK AND OTHER MATERIALS:

- Linear Algebra and Its Applications**, by Lay, McDonald, Lay; 6th Edition; Pearson, 2020
 - You DO NOT NEED MYLAB MATH** although that is one way to get the e-book if you want
- OPTIONAL BUT RECOMMENDED (AND FREE! 😊)**
 - Old Dominion University has a **Linear Algebra Tool-kit** and there are many others (online resource).
 - Mathematica** (FREE via COS Download [INFO](#)) may also be helpful although it is not Linear Algebra specific.

COURSE LEARNING OBJECTIVES:

- GMU Catalog:** “Systems of linear equations, linear independence, linear transformations, inverse of a matrix, determinants, vector spaces, eigenvalues, eigenvectors, and orthogonalization.”
- Glenn’s Additional Objectives:** Prepare you to be successful in future math, physics, science, engineering, computer, and other courses; enhance your problem solving skills, intuition, and insight. Also, help you to be an effective and valued employee in your career field someday.

Major points of emphasis will be to cultivate your skills to:

- Obtain a solid understanding of the concepts/theory of the course, master the problem solving techniques, and execute correct and well organized/well documented solutions to problems**
 - Analyze problems and solutions** to understand what they mean, how they behave, determine the proper analytical technique(s), and when/where they are valid to keep out of trouble and not misapply a technique
 - Do a “sanity check” to see if your answer makes sense** – e.g., does it have the correct properties? Does it fall within reasonable upper and/or lower bounds based on a “ball park” estimate or limiting case?
 - Self-reliance, BUT also knowing when/how to ask for help. I HIGHLY ENCOURAGE QUESTIONS.** However, before asking a question you should “do your homework” first – literally and figuratively. **Come PREPARED.**
- Many students have difficulty solving problems due to one or more of the following issues:**
 - Not **diagnosing the problem** and developing a **strategy before** they start and go down the wrong path
 - Not taking an **organized approach** to problem solving. **You should:** organize the information, determine what is known and what is unknown, write down the fundamental equation(s) that govern the problem, draw a picture/diagram or make a table to help visualize the problem and solution
 - Making **fundamental algebra, arithmetic, and other errors**, and/or not checking their work.

COURSE APPROACH: WE WILL EMPHASIZE THE FUNDAMENTALS

- (1) Learn how to **diagnose** and “**attack**” problems to **determine the problem type**, underlying **concept(s)**, appropriate problem solving **technique(s)**, and to master the **mechanics** of executing the solution
- (2) **Proofs and/or derivations of key theorems and techniques** – these are **essential** for learning and **understanding** the “5Ws” (i.e., the “**who, what, when, where, why, and how**”) which is **crucial** to **really** learning the material.

HOMEWORK EXERCISES:

- WORD TO THE WISE:** **If you don’t do a thorough and comprehensive job on the homework exercises, you will almost certainly fail the course – it is that simple.** Many have tried to short-change the homework process, myself included, and it always ends VERY badly. **Homework is not collected nor does it count directly in your grade. However, it has a HUGE indirect impact on your grade.**

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GRADES: COURSE AVERAGE COMPUTATION AND GRADE SCALE

Graded Item	Nominal	Max Final	NO FINAL*
Midterm Exams	60% (All 3)	40% (Best 2)	95% (All 3)
Comprehensive Final Exam	40%	60%	Not Required
Weekly Quizzes:	5% extra credit	5% extra credit	5%* (not extra credit)
* This option is ONLY available to students with a course average ≥ 92 using this weighting scheme			
TOTAL	105%	105%	100%

- A course average will be calculated for each student using all three weightings. For each student, on an individual basis, **I will use your HIGHEST average to determine the overall course grade using the grading scale below.**

F (0.0)	D (1.0)	C- (1.67)	C (2.0)	C+ (2.33)	B- (2.67)	B (3.0)	B+ (3.33)	A- (3.67)	A (4.0)	A+ (4.0)	Letter Grade (Grade Points)
< 60	≥ 60	≥ 70	≥ 72	≥ 78	≥ 80	≥ 82	≥ 88	≥ 90	≥ 92	≥ 100	Course Average

- Grades are based on an absolute 100-point scale and NOT using a “curve”.** Your performance will be evaluated relative to what you need to achieve in order to be successful in future courses rather than relative to your classmates’ performance (i.e., a curve). **You will have opportunities to earn extra credit on exams as they will have 10% extra credit built-in (i.e., 110 points). Quizzes are also a great way to keep up and earn extra credit.**
- Speaking of Extra Credit: There are no extra credit assignments or other additional work during or at the end of the semester that can be done to boost your grade.** I still get asked every semester – and the answer is still “no”. The time to be diligent is **NOW**, not in desperation at the end of the semester.

EXAM & QUIZ POLICIES:

- ALL QUIZZES ARE TAKEN ONLINE DURING THE PRESCRIBED AVAILABILITY WINDOW**
 - Quizzes will be **due no later than the start of class each Monday** and will cover the chapter sections done in class the previous week. Quizzes will be posted well in advance so that you can do them on your own time-table.
 - LATE IS LATE – no exceptions:** Quizzes that are submitted after the deadline or that utilize more than the allotted time will receive no credit – zero, nada, zilch, هیچ یک, لاأح, कोई नहीं, 没有任何, 없음
 - I will provide basic guidelines regarding file types, image formats, and other administrative details relative to submitting your “free response” solutions to quizzes on Blackboard. These guidelines are fairly simple and are designed to greatly reduce the handling time so that I can spend more time thoroughly evaluating students’ work and providing feedback rather than reformatting images, managing 80+ files named “Quiz-3” with no name, etc. **PLEASE FOLLOW THESE GUIDELINES, failure to do so may result in deductions**
- EXAMS DATES ARE SHOWN ON THE COURSE SCHEDULE AND WILL CONSUME THE ENTIRE 75 PERIOD ON THOSE NIGHTS.** I will provide a reference sheet of key definitions, theorems, etc. which I will post in advance. This is NOT so that you don’t have to learn/remember them. The purpose is so that you can properly justify your results by citing the relevant theorems etc. by name (or chapter and number).
- ALL QUIZZES ARE OPEN BOOK, OPEN NOTE, OPEN HOMEWORK AND YOU MAY USE THE CALCULATOR OF YOUR CHOICE FOR ARITHMETIC ONLY – NOT MATRIX OPERATIONS – I want to see your BY-HAND work.**
 - However, don’t be fooled into thinking that just because you have these references, you don’t need to thoroughly understand course concepts and techniques and be well-practiced in problem-solving – YOU DO
 - QUIZZES ARE NOT** open Internet, open classmate/friend, open computer software, calculator matrix functions
 - SHOW YOUR WORK!!!!!!**
 - There needs to be a **complete and correct path** from the problem statement to your overall solution in order to receive full credit for a problem; **NO/VERY LITTLE WORK SHOWN = NO/VERY LITTLE CREDIT**
- MAKEUP MIDTERM EXAMS AND QUIZZES: NONE** except consistent with GMU policy as stated below
 - There will be **no makeup exams or quizzes** except as described below. Missed exams/quizzes will receive a 0.
 - Per **GMU Academic Policy A.P.1.6.1**, you may be able to take a midterm exam or quiz at an alternate time **WITH PRIOR ARRANGEMENT**. This applies only to situations involving:
 - Religious Observance** - I have done my best to de-conflict the course schedule with religious holidays. However, if the schedule changes or there is a situation/conflict I am not aware of, please let me know.
 - Mandatory Participation in Official University Activities** (e.g., intercollegiate athletics, GMU band)

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- If you have a conflict, please let me know ASAP. **Last minute requests (< 48 hours) will not be considered regardless of circumstances.** Planning ahead is an important survival skill in the “real world”.
- If you have **truly extraordinary circumstances** that aren’t covered by the GMU policy above, please see me. I’ll listen but it needs to be a **VERY** good reason in order to arrange for a make-up exam (*but no quiz make-ups*).
- **COMPREHENSIVE FINAL EXAM:**
 - **IMPORTANT NOTE:** Per GMU Policy [A.P.3.10](#), you **must** take the final exam at the regularly scheduled date and time unless you have **excused absence in writing signed by your Dean or Academic Director**.
 - GMU policy allows you to arrange an alternate day/time if you have a direct conflict between final exams or more than two final exams on one day. If so, **let me know at least one week prior to the final exam**.

WHAT TO EXPECT ON MIDTERM EXAMS AND QUIZZES:

- On **all** exams and quizzes, regardless of topic, I will be looking for you to demonstrate:
 - 1) **A well-organized solution with a logical and mathematically correct progression from each step to the next**
 - **SHOW YOUR WORK:** don’t leave large gaps between steps, be careful with use of an equal sign → both sides of an equality must truly be equal or else it is an incorrect statement; ensure proper use of notation
 - **WHAT YOU WRITE DOWN MATTERS** - even if you understand what you are doing, you need to properly communicate that understanding to me (and later colleagues, boss, etc.). **USE PROPER NOTATION**
 - 2) **Good problem solving skills:** The ability to **DIAGNOSE** a problem to determine the type of problem, recognize and understand the **FUNDAMENTAL CONCEPT(S) INVOLVED**, determine and properly apply the **APPROPRIATE PROBLEM SOLVING TECHNIQUE(S)**, and correctly **EXECUTE THE MECHANICS** technique(s)
 - 3) **Correct analysis, understanding, and interpretation of the solution:** For example:
 - Analyzing the properties/behavior of a solution to understand what it means, seeing if the solution passes a “sanity check” and/or estimating upper and/or lower bounds for the answer
 - Proper geometric interpretation of a problem and its solution; describe/sketch the solution when possible.

WHAT TO EXPECT ON THE COMPREHENSIVE FINAL EXAM:

- The **emphasis will be on major course concepts/techniques**, particularly putting them together to solve “compound” problems, applications, and understanding of the “big picture” and “the 5W’s”

HONOR CODE: THIS IS VERY IMPORTANT

- **It is expected that each student in this class will conduct himself or herself within the guidelines of the Honor Code.** Among other things, this means that sharing information of any kind about exams (either before or during the exam) is forbidden as well as use of prohibited material or devices. Any alleged issues related to the honor code will be brought to the attention of the Office of Academic Integrity. Please read the [University Honor Code](#) and abide by it.
- **This is especially important given that quizzes are on-line using an honor system.**

GETTING HELP:

- **Don’t let a small problem turn into a big one by getting behind – it will be very difficult to catch up.**
 - **Contact me** via email and/or come see me during regular office hours or make an appointment.
 - **The Math Tutoring Center**, Johnson Center, Room 344: <http://math.gmu.edu/tutor-center.php>
 - **Internet Resources:** There are tons of good stuff (and lots of crap too so be careful of your sources); here are a few I like, just be aware of possible differences in notation from our textbook
 - **3Blue1Brown Series (Videos):** [The Essence of Linear Algebra](#); **THESE ARE EXCELLENT**
 - **The Kahn Academy Tutorials:** [Linear Algebra Home Page](#) (also very good)
 - **Open Courseware (OCW):** Over 240 institutions participate in the [Open Education Consortium](#), many of which are top universities such as [MIT](#) (MIT has a very extensive set of materials, videos, etc.)
 - **Wolfram Mathematica Demos:** [Linear Algebra Examples](#), [Matrices and Linear Algebra](#)

CLASS WEB PAGE/COMMUNICATION:

- I will post all class materials, announcements, scores/grades on **Blackboard** and send some things via GMU email.
- **The primary way to contact me is via GMU email (gpresto3@gmu.edu)**

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- To comply with GMU policy and protect your privacy, I will only send email from my GMU account to your GMU email address. **Please only send email to me from your GMU email so I can use the “reply” function in responding to you.**
- I will try to reply to each email ASAP and within 24 hours if at all possible. Please bear in mind that just like you, I “have a life” which may occasionally delay my response. As an alternate means of contact/last resort in case of **emergency** you can **text** me at (703) 405-0344 (text only please, I don’t answer calls from unknown numbers)

OTHER TOPICS:

- **Class Schedule:** The last page shows the nominal schedule for lecture topics, exam dates, homework exercises. Modifications to the schedule may be required. **You are responsible for being aware of any announced, emailed, and/or posted changes to the schedule.**
- **Syllabus:** Ya, this thing. **Please read it (RTFS) and please check the syllabus before asking questions that can be easily answered on your own. QUESTIONS ARE ENCOURAGED.** However, when you get a job, if you ask lots of questions that you could have/should have answered on your own, pretty soon your boss and colleagues will wonder what value you are adding to the team, you will get the crap work, be slow to advance, and possibly be fired.
- **Attendance:** **Will not be taken and there is no “participation” component to your grade.** It is **your** choice/responsibility to show up for class, be prepared, and get something out of it. **REGARDLESS OF WHETHER YOU ATTEND CLASS REGULARLY OR NOT, IT IS VITAL THAT YOU KEEP PACE WITH THE COURSE SCHEDULE.**
- **University Policies:** Please familiarize yourself with university policies. The University Catalog, <http://catalog.gmu.edu>, is the central resource for university policies affecting student, faculty, and staff conduct in university academic affairs. All members of the university community are responsible for knowing and following established policies and procedures. (See also <http://universitypolicy.gmu.edu/>)

OTHER UNIVERSITY RESOURCES AND LINKS:

- **Mathematical Sciences Department:** Exploratory Hall room 4400, (703) 993-1460
- **Office of Disability Services** (ODS): Student Union Building I, Room 211, (703) 993-2474. All academic accommodations must be arranged through ODS. If you are a student with a disability and need academic accommodations, please contact ODS as soon as possible and do not hesitate to speak confidentially with me.
- **Counseling And Psychological Services** (CAPS): Student Union Building I, Rm 3129, (703) 993-2380
- **Veterans: Office of Military Services:** SUB I, Suite 1510 (next to Chik-Fil-A) , (703) 993-1316

DIVERSITY AND INCLUSION:

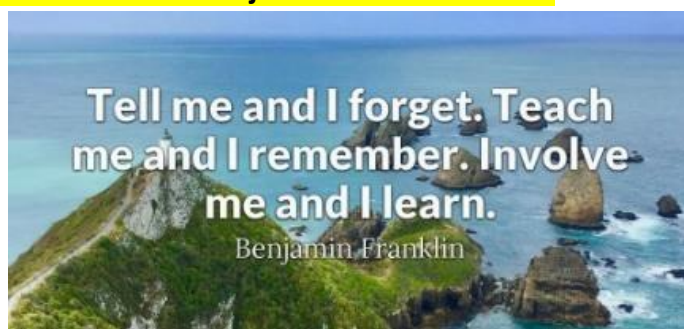
- All aspects of this course will be conducted in accordance with GMU’s [Non-Discrimination Policy](#) and [Diversity Statement](#). **ALL** of us need to be cognizant of, and adhere to, our responsibilities to make our class welcoming to all.

MY COMMITMENT TO YOU:

- You have a right to expect certain things of me. My commitment to the class is that I will:
 - Do my best to follow my own advice/rules and lead by example – i.e. I will try to **“practice what I preach”**
 - Be as honest, open, and transparent as possible in how I conduct the class, consistent with maintaining proper student privacy/confidentiality and the academic integrity of the course.
 - Treat every student with respect and as an individual having individual talents and needs, within the constraints of doing what is best for the class as a whole.

- **Bottom Line: To be successful in this course you will need to do more than just the bare minimum**
→ **I am ready, willing, and able to do more than the minimum required of me as well**

- I will hold extra office hours, review sessions prior to exams, provide “chapter notes”, detailed homework solutions, and other supplemental material – whatever I can legitimately do to help students realize their potential.
- But bear in mind:
You learn by doing and I can’t “do the doing” for you.



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*** Class Lecture/Exam/Homework Schedule ***

Prior to Each Class:

- **GOOD:** Make sure you have completed homework from all prior chapter sections. Seek help as needed.
- **BETTER:** Read upcoming section(s). WORK THROUGH THE EXAMPLES IN THE TEXT PRIOR TO CLASS
- **BEST:** Try the homework for the upcoming section(s): Do what you can, make a list of questions for the rest.

Course Schedule

WK	MON	WED
1	23 AUG Intro/Overview	25 AUG 1.1, 1.2
2	30 AUG 1.2, 1.3	1 SEP 1.4, 1.5
3	6 SEP Labor Day NO CLASS	8 SEP 1.5, 1.7
4	13 SEP 1.8, 1.9	15 SEP 1.9, 6.1
5	20 SEP 6.2, Review	22 SEP Exam-1 Ch. 1 & 6
6	27 SEP 2.1, 2.2	29 SEP 2.2, 2.3
7	4 OCT 2.8, 2.9	6 OCT 2.9, 3.1
8	TUE 12 OCT 3.2, 3.3	13 OCT 3.3, Review
9	18 OCT Exam-2 Ch. 2, 3	20 OCT 4.1, 4.2
10	25 OCT 4.2, 4.3	27 OCT 4.3, 4.4
11	1 NOV 4.5, 4.6	3 NOV 4.6, 5.1
12	8 NOV 5.1, 5.2	10 NOV Review
13	15 NOV Exam-3 Ch. 4, 5.1, 5.2	17 NOV 5.3, 5.5
14	22 NOV 5.5, 5.7	24 NOV THANKSGIVING BREAK
15	29 NOV 5.7	1 DEC Review
Comprehensive Final Exam Wed 8 Dec 7:30 – 10:15 PM		

Homework Exercises (x – y = ODD ONLY)

Ch	Chapter / Section Title	Exercises
1: Linear Equations in Linear Algebra (Exam 1)		
1.1	Systems of Linear Equations	1 – 13, 19 – 23, 27 – 33, 37
1.2	Row Reduction and Echelon Form	1, 3, 7 – 13, 23, 25 – 33
1.3	Vector Equations	1 – 5, 9 – 13, 17, 23 – 31
1.4	The Matrix Equation $Ax = b$	1 – 33, 43
1.5	Solution Sets of Linear Systems	1 – 11, 17 – 35
1.7	Linear Independence	1 – 11, 15 – 27, 37
1.8	Introduction to Linear Transformations	1 – 29
1.9	The Matrix of a Linear Transformation	1, 3, 9, 15 – 35
6: Orthogonality and Least Squares		
6.1	Inner Product, Length, Orthogonality	1 – 27, 31
6.2	Orthogonal Sets	1 – 21
2: Matrix Algebra (Exam 2)		
2.1	Matrix Operations	1 – 11, 15 – 25, 35
2.2	The Inverse of a Matrix	1, 3, 7 – 19, 39 – 45
2.3	Characterization of Invertible Matrices	1 – 7, 11 – 19, 23, 25, 41
2.8	Subspaces of \mathbb{R}^n	1 – 11, 15 – 33
2.9	Dimension and Rank	1 – 5, 9 – 25
3: Determinants (Exam 2)		
3.1	Introduction to Determinants	1 – 23, 39, 41
3.2	Properties of Determinants	1 – 15, 19 – 25, 29, 33
3.3	Cramer's Rule, Volume, & Linear Trans.	1, 3, 15, 19 – 23, 27
4: Vector Spaces (Exam 3)		
4.1	Vector Spaces and Subspaces	1 – 17, 23, 27 – 31
4.2	Null, Column, and Row Spaces; Linear Trans.	1 – 35, 39
4.3	Linearly Independent Sets; Bases	1 – 15, 21 – 29
4.4	Coordinate Systems	1 – 19
4.5	The Dimension of a Vector Space	1 – 19, 23 – 29, 43 – 47
4.6	Change of Basis	1 – 13
5: Eigenvalues and Eigenvectors (Exam 3)		
5.1	Eigenvalues and Eigenvectors	1 – 17, 21 – 27
5.2	The Characteristic Equation	1 – 17, 21 – 27
5: Eigenvalues and Eigenvectors Cont'd. (On Final Exam)		
5.3	Diagonalization	1 – 13, 17, 21 – 25
5.5	Complex Eigenvalues	1 – 9, 13, 15, 21
5.7	Applications to Differential Equations	1 – 13

➔ Weekly quizzes posted on Blackboard are due NO LATER THAN THE START OF CLASS EACH MONDAY, except as noted in the schedule above, and will cover the chapter sections from the prior week (see posted quiz schedule on Blackboard)