Mathematics 203 – 003; Linear Algebra; Spring 2022 *(CRN 82933)*

Class Schedule:	**Mon & Wed: 1:30 – 2:45 PM**	**Location:**	**Enterprise Hall 178**
Class Dates:	**Mon 24 Jan – Wed 4 May**	**Final exam:**	**Wed 11 May 1:30 – 4:15 PM In Classroom**
Instructor:	**Mr. Glenn Preston**	**Email:**	**gpresto3@gmu.edu**
Office:	**Exploratory Hall 4309**	**Office Hours:**	**Mon & Wed 11:00 AM – 1:00 PM and by appt.**

PREREQUISITES:

- Grade of C or higher in Math 114, 114T, or 116

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:

  (1) 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

  (2) 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

  (3) 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?

  (4) 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 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**
"Pop" 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 and in your career rather than relative to your classmates' performance (i.e., a curve).
- **You will have opportunities to earn extra credit.** Exams 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.
  - **If you are planning to graduate at the end of this semester**, the time is **NOW** to make sure that this course does not prevent you from graduating. **There is nothing you are I can do at the end of the semester** if you don't achieve a C or higher. At the **first** sign of trouble, I expect to see you in my office frequently.

EXAM & QUIZ POLICIES AND PROCEDURES:

- **In-Class "Pop" Quizzes**
  - There will be approximately 8 unannounced in-class quizzes covering recently covered material, typically from the previous week. These will be given at the end of class and will typically last 15 to 20 minutes.
- **Mid-term and Comprehensive Final Exams:**
  - Exam dates are shown on the course schedule and mid-terms will consume the entire 75 period on those nights.
  - Per the discussion above regarding grades, IF it is to your advantage, your lowest midterm score will be dropped **("Max Final"** weighting). IF you qualify for the **"No Final"** option, you can choose to waive the final and receive your current grade as of the last day of classes (would be an A or A+ using the "No Final" weighting)
- **GENERAL POLICIES FOR EXAMS AND QUIZZES**
  - **There will be NO MAKE-UP exams or quizzes except for excused absences that are consistent with GMU policy**
    - **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:

      (1) 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.

      (2) Mandatory Participation in Official University Activities (e.g., intercollegiate athletics, GMU band)
    - **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 quiz or exam
  - **SPECIAL RULES FOR THE 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.**

- You may **use the calculator of your choice for arithmetic only** – not matrix operations – I need to see your BY-HAND work. You can CHECK your answer with your calculator using matrix operations but not to derive it.
- **I will provide a reference sheet** *(exams only, not on quizzes)* 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).**
- **SHOW YOUR WORK!!!!!! ➔ Even if you answer is correct, you MUST show your work to receive credit**
- **BATHROOM BREAKS: Mid-term Exams:** "Discouraged"; **Final Exam:** Allowed

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.

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.). **You may need to poke around a bit to find things like these excellent videos: http://mathispower4u.com/linear-alg.php**
    - **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**. BB announcements will be auto-sent to your GMU email address. email.
- **The primary way to contact me is via GMU email (gpresto3@gmu.edu)**

- 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:

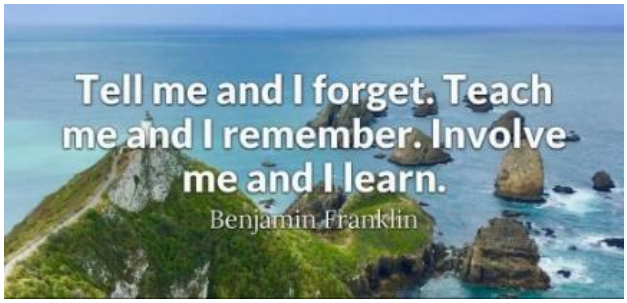
- **Mathematical Sciences Department**: Exploratory Hall room 4400, (703) 993-1460
- **Office of Disability Services** (ODS): Student Union Building I, Room 211, (703) 993-2474**.** All academic accommodations must be arranged through ODS. If you are a student with a disability and need academic accommodations, 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	24 JAN	26 JAN
	Intro/Overview	1.1, 1.2
2	31 JAN	2 FEB
	1.2, 1.3	1.4, 1.5
3	7 FEB	9 FEB
	1.5, 1.7	1.8, 1.9
4	14 FEB	16 FEB
	1.9, 6.1	6.1, 6.2
5	21 FEB	23 FEB
	Catch-up/Review	Exam-1 Ch. 1 & 6
6	28 FEB	2 MAR
	2.1, 2.2	2.2, 2.3
7	7 MAR	9 MAR
	2.8, 2.9	2.9, 3.1
8	14 MAR	16 MAR
	NO CLASS – SPRING BREAK	
9	21 MAR	23 MAR
	3.2, 3.3	3.3, **Review**
10	28 MAR	30 MAR
	Exam-2 Ch. 2, 3	4.1, 4.2
11	4 APR	6 APR
	4.2, 4.3	4.3, 4.4
12	11 APR	13 APR
	4.5, 4.6	4.6, 5.1
13	18 APR	20 APR
	5.1, 5.2	Catch-up/Review
14	25 APR	27 APR
	Exam-3 Ch. 4, 5.1, 5.2	5.3, 5.5
15	2 MAY	4 MAY
	5.5, 5.7	Catch-up/Review

Comprehensive Final Exam
Mon 11 May 1:30 – 4:15 PM
In Classroom

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 A**x** = **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

➔ **There will be approximately 8 unannounced extra credit quizzes during the semester, before and between each exam (3 midterms and final)**