Linear Analysis: MATH 675 GMU

Fall 2021

Instructor:	Dr. Mahamadi Warma	**Time:**	**TR: 5:55 PM–7:10 PM**
Email:	mwarma@gmu.edu	**Place:**	**Exploratory Hall 4106**

Office Hours: TR 4:30 PM–5:30 PM or by appointment.

Office: Exploratory Hall, room 4461.

Phone: 703-993-1488.

Textbook and Material: We will cover Chapters 2, 4, 5, and 6 in the following text book:

- Introductory Real Analysis by A.N. Kolmogorov and S.V. Fomin (Dover, 1970).

But we notice that the materials of the course will not be necessarily presented in the same order as the mentioned text book.

Justification: The aim of this course is to introduce some basic and fundamental concepts and techniques of linear analysis. This is one of the fundamental course in mathematics that will led students to research in mathematical analysis, partial differential equations and its applications.

Objectives: At the end of the course, the students should be familiar with metric spaces, linear spaces, linear functionals, and linear operators.

Description:

- **Metric Spaces**: Basic definitions, convergence and contiuity, topological properties, completeness, separable metric spaces, completion of a metric space, compactness.
- **Linear Spaces**: Linear spaces, Frechet spaces, Banach spaces, finite-dimensional Banach spaces, compactness of the unit sphere, Hilbert spaces, orthonormal sets, orthogonal sets, orthogonal projections.
- **Linear Functionals**: continuous linear operators, the Banach algebra $\mathcal{L}(X)$, dual spaces, the Hahn-Banach theorem, reflexive spaces, weak convergence, weak topology and compactness.
- **Linear Operators**: inverse operators, adjoint operators, solvability conditions, spectrum and resolvent, completely continuous operators, the Fredholm-Riesz-Schauder theorem.

Material Covered:

- Metric Spaces: 3 weeks
- Linear Spaces: 2 weeks
- Linear Functionals: 3 weeks
- Linear Operators: 4 weeks.

Recommended Prerequisite: MATH 315 and MATH 322, or equivalent.

Homework: Problems will be assigned regularly throughout the semester. Students are expected to solve all the assigned problems, and some of these problems will be handed in and graded. Students are allowed to discuss assigned problems with classmates, but solutions should be written individually.

Tests: There will be one midterm and one final exam. All tests are closed-book and closed-notes.

Grading Policy: The graded homework for 40%, midterm exam for 30%, and the final exam for 30%. Equivalence between scores and letters, recommended by GMU, is given in the table below:

A+	A	A-	B+	B	B-	C+	C	C-	D	F
>97	>93	>90	>87	>83	>80	>77	>73	>70	>60	60-0

Other useful books:

- P. Ciarlet, Linear and Nonlinear Functional Analysis with Applications, SIAM 2013.
- E. Kreyszig, Introductory Functional Analysis and Applications, Wiley, 1978.
- B.D. MacCluer, Elementary Functional Analysis, Springer, 2009.
- G.K. Pedersen, Analysis Now, Springer, 1989.
- B.P. Rynne and M. A. Youngson, Linear Functional Analysis, Springer, 2008.

Attendance and Course Policy:

- Students are expected to participate in all classes. In the event that you must miss a class, you are responsible to ask classmates concerning announcements made and the material discussed.
- Makeup exams are only possible with an acceptable excuse. Examples of such excuses are religious holy days, family emergencies, school sponsored events, job interviews, or sickness. All absences require documentation. Notify me of any religious holy days within the first 2 weeks of the semester. Changing the date of the final exam for unusual circumstances, or because three or more finals are scheduled in one day, requires the approval from the professor at least a week prior to the last day of classes. If absence from the final exam is unexcused, the grade for the course is F.

Cellular Phones in the Classroom: Students must turn off all cellular phones and other communication devices when in the classroom. Emergency personnel should notify the professor at the beginning of the course and set phones to vibrate mode.

GMU Policies: The University Catalog, http://catalog.gmu.edu, is the central resource for university policies in university academic affairs. Further policies are available at http://universitypolicy.gmu.edu/ All members of the university community are responsible for knowing and following established policies.

Honor Code: Students are expected to follow the honor code https://oai.gmu.edu/mason-honor-code/ Lack of knowledge of the honor code is not a reasonable excuse for its violation.

Disability Services: Reasonable accommodations are available for students who have a documented disability. Please contact Disability Services if you require accommodations: Office of Disability Services, Student Union Building I (SUB I), Room 4205, Phone: 703-993-2474.