The University of Memphis
Department of Mathematical Sciences

MATH 7355/8355 **Functional Analysis I** **Spring 2020**

Instructor: Dr. Thomas Hagen, Professor
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Class Time/Location: TR 1:00 pm to 2:25 pm in Dunn Hall 249

Office Hours: TR 10:15am to 11:00am in Dunn Hall 237
(It is a good idea if you let me know ahead of time that you want to see me in my office hours.)

Course Description: Functional analysis is a central topic in analysis at a truly advanced level and is at the heart of many subdisciplines of analysis, including real, complex and harmonic analysis as well as ordinary and partial differential equations. It has been called the "marriage of analysis and algebra." In fact, this is a "happy" marriage with many remarkable off-springs: Metric spaces, including Hilbert and Banach spaces; linear functionals, convexity and weak topologies; duality; uniform boundedness, open mapping, and closed graph theorems; linear operators: spectra and spectral mapping theorems; Banach algebras

Text: We will be using the following textbook as a rough course guide:
1. **Elementary functional analysis**[E] by B. D. MacCluer, Springer, 2009
We will discuss selected topics from Chapters 1-6, plus possibly some additional material. The appendix is largely foundational.

Other relevant texts with a somewhat different scope and of varying difficulty include:
2. **A course in functional analysis**[R] by J. B. Conway, Springer, 1985
3. **A guide to functional analysis**[E,R] by S. G. Krantz, MAA, 2013
4. **Introductory functional analysis with applications** by E. Kreyszig, Wiley, 1989
5. **Functional analysis** by W. Rudin, McGraw-Hill, 1973
6. **Real and complex analysis**[R] (3rd ed.) by W. Rudin, McGraw-Hill, 1987
7. **Introduction to functional analysis** (2nd ed.) by A. E. Taylor and D. C. Lay, Wiley, 1980
8. **Functional analysis**[R] by K. Yosida, Springer, 1968

Items marked by [E]: Electronic resource – see the library web pages
Items marked by [R]: Library reserve – may be borrowed for 4 hours

All the texts above are intended for reference and further exposition. They cover a lot more material and do so in a different order and with a different emphasis. Hence, they are not to be understood as a substitute for the lectures nor as a red line which the lectures must follow.

Prerequisites: To be successful in this course, you must have had a good introduction to real analysis and linear algebra. Traditionally, functional analysis follows a course on real variables. This course assumes no exception. The course contents are heavily geared towards proofs.

Three Keys to Learning Functional Analysis

1. Work lots of problems.
2. Memorize definitions and statements of major results exactly.
3. Work lots more problems.

Homework: Homework problems will be assigned regularly. You are encouraged to do as many as possible. You may turn in the problems in any order and at any time as long as they are neatly written up with authorship clearly indicated (a thin folder might be helpful). **The solution of each problem is to be submitted on separate sheets of paper.** Full credit will be given for a problem only after a solution has been accepted as correct and is reasonably well written (sloppy or unorganized work is returned with no check for accuracy and no points given). If a solution attempt is rejected, you have a chance to resubmit once, but no later than April 23, 3pm. Be aware that a check for accuracy will require a minimum of one work week (and for large submissions possibly much longer). Hence plan accordingly. **No check for accuracy prior to submission!**

Homework discussions among all students are generally welcome if everybody contributes. Up to two people may submit joint problem solutions for full credit. However, it is unethical (and unacceptable) to submit joint work if one co-author's contribution is insignificant. Also, homework is not an exercise in finding solutions online or in books. It is solely intended to make you become familiar with the material from the lectures and force you to develop and sharpen your problem-solving skills.

Grades: The grade range is from A to F. The plus-minus system will not be used. Grades will be based on homework solutions plus an optional final exam. Attendance and participation might also factor into your grade at the instructor's discretion, especially for students at the borderline of two grades.

You collect credit for homework as follows:

- 4 points for every submitted problem (where a reasonable effort is demonstrated, and the write-up is neat and orderly)
- 6 additional points for every accepted solution

Grading scheme for MATH 7355

A	B	C
At least 55% of all points	At least 40%, but less than 55%	At least 25%, but less than 40%

Grading scheme for MATH 8355

A	B	C
At least 60% of all points	At least 45%, but less than 60%	At least 30%, but less than 45%

Final Exam: The final exam will consist of questions about definitions and theorems or related results from the course. It will not contain "problems." The final exam is optional and should encourage you to memorize the key topics of the course. An "A" on the final will bump up your average by an additional 10%, a "B" by 5%, a "C" by 2% (final exam scale: "A" from 86-100%, "B" from 71-85%, "C" from 56-70%). For everything below a "C" you will earn nothing.

Final exam date: May 7, 10:30 am to 12:30 pm