

## MIDTERM 2 STUDY GUIDE

MATH 4121, SPRING 2019

**Material.** The midterm will cover chapter II and sections III.1 III.2 in Chae. Chapter I won't be explicitly covered on the exam but may be covered implicitly: some chapter I topics, such as measure zero, continue to be relevant in chapters II and III. Here is a **non-exhaustive** list of topics:

- Section II.1: Characteristic functions, step functions, positive/negative parts, properties of step functions and their integrals.
- Section II.2: Convergence almost everywhere.
- Section II.3:  $L^+$ , integration of  $L^+$  functions, properties of  $L^+$  functions and their integrals, relationship between  $L^+$  and Riemann integrability, functions that are not in  $L^+$ .
- Section II.4: Lebesgue integrable functions, properties of Lebesgue integrable functions and their integrals.
- Section II.5: Beppo Levi Theorem, Monotone Convergence Theorem, other results that follow from these theorems.
- Section II.6: Dominated Convergence Theorem (called the Lebesgue Theorem), Fatou's Lemma.
- Section II.7:  $L^1$ , the  $L^1$  norm, Banach spaces, density of continuous functions.
- Section III.1: Measurable functions, properties of measurable functions, criteria for a measurable function to be integrable.
- Section III.2: Measurable sets, Lebesgue measure, properties of measurable sets, countable additivity, countable subadditivity, continuity of measure for sequences of nested sets.

**Study suggestions.** My recommendation is to study by writing down a problem you think would be a reasonable problem for the exam, closing your book, solving it, checking your work, and fixing any mistakes. If you solve it easily, set that topic aside; if you have trouble, do additional problems on that topic, or let some time pass and then try the same problem again.

**Problem sources.** Here are some good sources of problems that you should use while studying (and I'll use while writing the exam for the most part).

- Stating definitions, theorems, etc.
- Proving things we proved in class. Keep in mind length: If a claim takes more than 15 minutes to prove, it's probably too complex for the exam. Maybe there's a lemma or a portion of the proof that's short enough and self-contained.

- Examples and counterexamples. Counterexamples are in some sense a mnemonic device for remembering when something works and when it doesn't.
- Homework problems. Again, keep in mind length. If it's too long, it won't be on the exam, unless there's a self-contained piece that's shorter.
- Other textbook problems or problems from Apostol. If a topic is causing a lot of trouble, doing the same homework problem over again will be limited in its usefulness; you might want to try something new for extra practice.

**Resources.**

- I have office hours scheduled Tuesday before the exam; if those times don't work for you, send me an email and we can schedule something, or send me an email with a question and I can try to answer it.
- Your classmates.
- The posted homework solutions.
- The textbook.
- The supplementary textbook (Apostol).