MATH 222 : ANALYSIS II – MEASURE & INTEGRATION
SPRING 2023

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Instructor: GAUTAM BHARALI http://math.iisc.ac.in/∼bharali/teaching.htm

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THIS IS THE LAST TIME THAT A HANDOUT WILL BE PASSED OUT IN HARD-COPY!
All future announcements/assignments will be posted on the course webpage.

Course summary: This course is an introduction to measure theory and integration, with a considerable emphasis on the real line and $\mathbb{R}^n$. We will begin with basic notions, set up the Lebesgue integral — for measures **in general**, but the Lebesgue measure on $\mathbb{R}^n$ will reappear as a recurring example — and study the main theorems on the limits of integrals. Next, we shall study product measures, and look at several important results in $\mathbb{R}^n$ that stem from Fubini's Theorem. Finally, we shall introduce signed measures. The Radon–Nikodym theorem and the Riesz Representation theorem will conclude the course.

Textbooks: Your class notes, and your own solutions to problems (provided they are clearly and systematically written) will form the core of the knowledge acquired from this course. I shall **not follow any single textbook.** The material presented will be sampled from the following:

1. G.B. Folland, *Real Analysis: Modern Techniques and their Applications, 2nd Edition*, John Wiley & Sons, 1999.
   (This is a good source of problems at the level at which the course will be taught)

2. E. Hewitt and K. Stromberg, *Real and Abstract Analysis, 3rd Edition*, Graduate Texts in Mathematics no. 25, Springer-Verlag, 1975.

3. H.L. Royden, *Real Analysis, 3rd Edition*, Macmillan, 1988.
   (I shall follow Royden's approach in most discussions concerning the real line.)

   In my treatment of **some** topics involving the $\mathbb{L}^p$ spaces, I shall loosely follow:
4. R.L. Wheeden and A. Zygmund, *Measure and Integral: An Introduction to Real Analysis*, Marcel Dekker, 1977.
   (**Optional;** recommended if you are interested in exploring deeper results in $\mathbb{R}^n$.)

Tutorials: 2:00–3:00 p.m. on **Mondays**

The importance of homework: During the course of the lectures, I shall indicate various problems — which will include points in the proof of a theorem being presented — for you to work on. These, plus other problems will be compiled into assignments. You will not be asked to submit this homework, but it is **essential** for your understanding of the subject that you work on these problems. Also see the section below on *quizzes.* On most weeks, a new assignment will be posted on the course webpage on **Tuesday night,** latest by midnight.

Assessment: Your assessment will be based on:

- **Quizzes:** The homework assignments will form the material for quizzes, which will be given during the tutorial. These **will not be announced** in advance! The problem(s) on the quiz

will be drawn from the most recent assignment that has been up on the webpage for **at least** 4 days.

- **Mid-semester examination:** To be announced by the end of January
- **Final examination:** This will be held during the final-examination week. Date and time will be decided in class some time in March.

  Weightage: Quizzes: *25%*, Mid-semester exam: *25%*, Final exam: *50%*

Tutor for this course: Babhrubahan Bose

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Office hour **:** To be determined if the need arises (most probably around the time of the mid-semester exam)