THE CHINESE UNIVERSITY OF HONG KONG

Department of Mathematics

MATH3060 (Fall 2024)

Mathematical Analysis III

LECTURES: W2 ERB 804; F2,3 AT ERB 404, TUTORIAL W1 ERB 804

Outline

This course is a sequel to MATH2050 and MATH2060. There are three topics in this course– Fourier series, metric spaces, and the space of continuous functions divided into four chapters.

Every math major should have learnt some Fourier series when they graduate. Indeed, this topic is supposed to be covered in 2060. It has been postponed until now due to lack of time. Those who are interested in this subject will learn much more from MATH3093 Fourier Analysis.

Metric space constitutes a special but important class of topological spaces. It aims to prepare the class for point set topology MATH3070. The contraction mapping principle on complete metric spaces enables us to provide proofs for two fundamental theorems, namely the implicit function theorem and the fundamental existence theorem for the Cauchy problem of differential equations. They were stated without proof in MATH2010 and MATH3270 respectively. The proof of the implicit function theorem is not easy. You may have a hard time facing it.

The space of continuous functions is perhaps the simplest infinite dimensional normed space (a special metric space). Two fundamental theorems, namely, the Arzela-Ascoli theorem and the Baire category theorem, will be discussed together with some applications. We will discuss some approximation results if time allows. General properties of normed spaces and linear operators will be covered in MATH4010 Functional Analysis. We hope to stimulate your interest in functional analysis through a case study on the space of continuous functions.

A thorough study on my lecture notes will be sufficient for this course. Materials for optional readings are for those who want to learn more. It is not intended for examination. Further references are suggested as we proceed, and they are for optional readings too.

Once again may I point out that we not only need to READ mathematics, we need to DO mathematics. Try to go through as many exercises as you can. They are organic components of the lecture notes. Don't just sit there and wait for the model answers.

Instructor

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Teaching Assistants

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References

- *Fourier Analysis–An Introduction*, E.M. Stein and R. Shakarchi, Princeton Lectures in Analysis, Princeton 2002.
- *Metric Spaces*, E.T. Copson, Cambridge U Press, 1968.
- *Advanced Calculus*, 2nd ed., P.M. Fitzpatrick, Thomson Brooks/Cole, 2006.

Grade

- 15% Assignments
- 40% Midterm Examination (Oct 25, 2024)
- 45% Final Examination