MATH3033 Real Analysis

L1, L2 (Fall 2026) Course Outline

1. Instructor

Name: Prof. ZHANG, Hai

Office: Room 3449

Email: haizhang@ust.hk

Office hours: Tue/Thu 3:00–4:00 PM, or by appointment.

2. Teaching assistants

Tutorial section	Teaching assistant	Email
T1A	HUANG, Yuntong	yhuanggu@connect.ust.hk
T1B	PING, An	apingaa@connect.ust.hk
T2A	SUN, Weixiao	wsunas@connect.ust.hk
T2B	WANG, Ruihe	rwangda@connect.ust.hk

3. Meeting time and venue

Lectures:

Section	Time	Venue	Instructor
L1	Tue/Thu 12:00–13:20	Room 4619, Lift 31–32	Prof. Hai Zhang
L2	Tue/Thu 09:00–10:20	Room 2306, Lift 17–18	Prof. Hai Zhang

Tutorials:

Section	Time	Venue	Teaching assistant
T1A	Wed 19:00–19:50	Room 4579, Lift 27–28	HUANG, Yuntong
T1B	Thu 18:00–18:50	Room 1409, Lift 25–26	PING, An
T2A	Thu 12:00–12:50	Room 6555, Lift 29–30	SUN, Weixiao
T2B	Tue 18:00–18:50	Room 5583, Lift 29–30	WANG, Ruihe

4. Course description

This is a rigorous course in real analysis in Euclidean spaces. The course develops the foundations of analysis needed for multivariable calculus and more advanced analysis. Major topics include set topology in $\mathbb{R}^n$, vector-valued functions, differentiation in several variables, the inverse function theorem, the implicit function theorem, sequences and series of functions, uniform convergence, Lebesgue measure, and Lebesgue integration.

Credit points: 4

Exclusions: None unless otherwise specified by the University.

Prerequisites:

(MATH 2010 or MATH 2011 or MATH 2021 or MATH 2023)
and
(MATH 2031 or MATH 2033 or MATH 2043)
and
(MATH 2111 or MATH 2121 or MATH 2131 or MATH 2350).

Recommended background: Students should be familiar with multivariable calculus, linear algebra, sequences, limits, continuity, differentiation, integration, and basic proof techniques.

5. Intended learning outcomes

Upon successful completion of this course, students are expected to be able to:

1. understand the logical deduction of important facts in mathematical analysis, especially in multi-dimensional spaces;
2. learn the foundations for multivariable calculus and basic measure theory, and more advanced techniques in analysis;
3. apply rigorous analytical techniques to problems involving convergence, continuity, differentiation, and integration.

6. Assessment scheme

- **Homework assignments (10%): Assessing ILOs 1, 2 and 3**

  Homework will be assigned during the semester and submitted through Canvas unless otherwise announced. Students are expected to write complete solutions with clear reasoning.

- **Midterm examination (25%): Assessing ILOs 1, 2 and 3**

  The midterm examination will be scheduled on **Thursday, October 29, 7:30–8:30 PM**. It will tentatively cover the materials taught before the midterm examination.

  There will be no make-up midterm examination. Special arrangements will be considered only in exceptional cases with valid and convincing documentation.

- **Final examination (65%): Assessing ILOs 1, 2 and 3**

  The final examination will take two hours. The date and venue will be arranged by ARO in due course. It will cover all materials taught in the course.

The midterm examination and the final examination will be **closed-book written** examinations. The exact examination arrangements may be modified in the event of unexpected emergencies.

Letter grades

The assignment of letter grades is criterion-referenced according to the grade descriptors below. The following thresholds are guaranteed:

Grade	Guaranteed threshold
A+	95% or above
A range	85% or above
B range	65% or above
C range	50% or above
Passing grade	40% or above

Grade descriptors:

Grade	Short description	Elaboration on subject grading description
A	Excellent	The student has mastered almost all important concepts and techniques of real analysis taught in the course, and has excellent and thorough conceptual understanding of the subject content. The student can present rigorous and logically complete arguments.
B	Good	The student has mastered most core concepts and techniques of real analysis taught in the course, although the understanding of some challenging concepts or proofs may not be deep enough.
C	Satisfactory	The student meets the minimum expectation of the instructor and has acquired some basic techniques of the subject, but some concepts may not be clearly understood.
D	Marginal pass	The student is only able to recall some fragments of topics and is able to complete some of the most elementary arguments or computations.
F	Fail	The student does not have sufficient understanding of even some fragments of topics and is not able to complete elementary arguments or computations.

7. Student learning resources

- Lecture notes and slides by the instructor.

  These materials will be made available through Canvas.

- Reference texts:
  - T. M. Apostol, *Mathematical Analysis*.
  - Min Yan, *Advanced Calculus*.

8. Learning Activities

Lectures: The instructor will present the main concepts, theorems, and essential mathematical ideas of the course, with an emphasis on rigorous reasoning and conceptual understanding.

Tutorials: The teaching assistants will discuss examples, review selected course materials, and help students develop problem-solving skills.

Homework: A set of problems for each chapter will be assigned through Canvas with a specified due date. Each student is required to submit their solutions through Canvas before the due date. The teaching assistants will grade the submitted work, and the marks will count toward the total course grade.

Additional practice problems may also be posted on Canvas for self-study. These problems are intended to help students consolidate their understanding and prepare for examinations, but they will not be collected or graded.

Communication and Feedback: Assessment marks for individual assessed tasks will normally be communicated via Canvas within two weeks of submission.

9. Tentative course schedule

Chapter	Duration	Topics
Chapter 1	2.5 weeks	Metric in $\mathbb{R}^n$; open sets; closed sets; neighborhoods; limit points; compact sets; basic topology in Euclidean spaces, limits and continuity.
Chapter 2	2.5 weeks	Vector-valued functions; differentiability in several variables; mean-value inequality; contraction mapping theorem; inverse function theorem; implicit function theorem.
Chapter 3	4 weeks	Sequences and series of functions; pointwise convergence; uniform convergence; continuity, integration, and differentiation of function series.
Chapter 4	2 weeks	Lebesgue measure; measurable sets; measurable functions.
Chapter 5	1.5 weeks	Lebesgue integration; convergence theorems.

The schedule is tentative and may be adjusted according to the actual progress of the class.

Use of generative AI tools:

The use of ChatGPT or other generative AI tools in assignments is not strictly prohibited, but it is not encouraged as a substitute for independent learning. While AI tools can be useful in exploring ideas and improving clarity of writing, students are warned against relying solely on AI to solve problems without truly understanding the underlying mathematical concepts and arguments. The use of generative AI tools is prohibited in the midterm examination and the final examination.

Academic Integrity

Students are expected to adhere to the University's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to *Academic Integrity — HKUST – Academic Registry* for the University's definition of plagiarism and ways to avoid cheating and plagiarism.