MATH 2043
Honors Mathematical Analysis
2024-25 Spring

https://canvas.ust.hk/courses/62265

Lecture

Time	Tuesday & Thursday 3:00pm - 4:20pm
Venue	Room 5583
Instructor	**Prof. Frederick Tsz-Ho FONG**
E-mail	frederick.fong@ust.hk
Office	Room 3488, Department of Mathematics

Tutorial

Session	**T1A**	**T1B**
Time	Wednesday 3:00pm - 3:50pm	Wednesday 9:30am - 10:20am
Venue	Room 2304	Room 2463
TA	**HU Mingyun**	**MOK Wan Hin**
E-mail	mhuae@connect.ust.hk	whmok@connect.ust.hk

Course Description

Course outline: It is the first part of a year-long honor course on real analysis targeted at mathematically mature undergraduate students. Topics include: supremum and infimum, completeness of real numbers, point-set topology of metric spaces, analysis of single-variable and multivariable functions, Riemann integrals, uniform convergence, etc.

Credits: 4

Prerequisites: Before taking this course, students should have already learned the rigorous ϵ, δ-definition of limit of functions and sequences of real numbers. The course is only recommended for those who obtained B range (preferably A range) in MATH 1023/1024. First year students who have workable knowledge and solid conceptual understanding of MATH 1023 can consider taking this course in parallel with MATH 1024 after receiving the pre-requisite waiver approval in SIS. Students whose Calculus 1 course got waived by GCEAL/IB/AP exams (and hence took MATH 1014 directly in Year 1) are NOT recommended to take this course unless they informally followed MATH 1023 material beforehand.

Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to:

(1) build a strong background on mathematical analysis, on real line and on metric spaces, for future studies in advanced courses in mathematics, statistics, and related subjects;
(2) be familiar with the rigorous treatment of single-variable, multivariable functions, and functions on metric spaces; and
(3) develop logical reasoning and critical thinking skills.

Student Learning Resources

Major Reference: Instructor's lecture notes posted on Canvas

Recommended References:

(1) *Principles of Mathematical Analysis* by Walter Rudin
(2) *Mathematical Analysis, 2nd Edition* by Tom Apostol
(3) Lecture notes written by Prof. YAN Min.

ASSESSMENT AND GRADING

Homework: There will be 4-5 problem sets. Students should submit each homework in form of a clearly scanned or LaTeX-typed PDF on the Canvas system before the deadline. The due time of Canvas is sharp. No late homework is accepted. You can form a group of at most 3 students and submit the homework as a group. Every member in the same group will receive the same score.

Examinations: There will be a 3-hour midterm exam during Week 6-8 (exact date to be confirmed), and a 3-hour final exam arranged by ARRO.

Make-up midterm policy:

- Under any circumstance, no make-up midterm test would be offered after the regular exam session.
- For students who have valid reasons for missing the midterm (such as time crash with another midterm), the instructor may approve an early midterm, or assign the midterm marks according to the final exam performance.
- On the other hand, for students who miss the midterm without a valid reason, the midterm score will be regarded as 0. This includes self-claimed sickness without any medical statement.

Make-up final exam policy:

For final exams, the course will follow the make-up exam policy set by ARO. Approval from the instructor, the dean, and ARO will be needed for applying for a make-up final exam, and students need to complete the make-up final exam within 1 week after the approval decision from ARO. In any circumstance, the make-up final exam will use a different set of problems, and there is no guarantee that the level of difficulty remains the same as the regular sitting.

Score Formula:

Total score

$$= \sup\{\lambda \,\text{homework} + \mu \,\text{midterm} + \nu \,\text{final} : \lambda \in [0, 0.2], \mu \in [0, 0.4], \nu \in [0.4, 0.7], \lambda + \mu + \nu = 1\}.$$

Grading Scheme: This course will be assessed using **criterion-referencing**, and grades will **not** be assigned using a curve. Try to aim at getting a total of 75% or above for an A-/A0/A+ grade, and about 50% or above for a B-/B/B+ grade.

Grade Descriptors:

Grades	Short Description A	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of mathematical analysis taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of real analysis, functional analysis, PDE, and related fields.
B	Good Performance	The student has mastered most techniques of mathematical analysis taught in the course, yet the understanding of some challenging concepts may not be deep enough for further studies on related advanced subjects.
C	Satisfactory Performance	The student meets the minimum expectation of the instructor, has acquired some basic techniques of the subject, yet some concepts were not clearly understood.
D	Marginal Pass	The student is only able to recall some fragments of topics and is able to complete some of the easiest problems.
F	Fail	The student does not have sufficient understanding of even some fragments of topics, and is not even able to complete some of the easiest problems.

Course AI Policy

Students are allowed to consult any person (including the instructor, TA, classmates, friends outside HKUST) in any homework for ideas and hints, but are required to write up the solutions by themselves. You are required to **list the persons and references** you have consulted in every homework.

The use of ChatGPT or other generative AI is allowed, and they are regarded as "persons" you have consulted, and therefore must be listed in your homework.

However, please be warned that at the current stage of development of AI, the response to problems in advanced courses – especially those in pure mathematics – is not quite reliable. Students should be critical of the response generated by AI and do not blindly copy the generated responses to your homework.

TENTATIVE SCHEDULE

Week #	Topics
1	Completeness Axiom of real numbers
2	limit superior and inferior
3	metric spaces: definitions and examples
4	point-set topology on metric spaces
5	point-set topology on metric spaces, con't
6	limit and differentiability of multivariable functions
7	Banach contraction mapping, inverse function theorem
8	higher-order differentiability
9	uniform convergence
10	uniform convergence, cont', Arzela-Ascoli's Theorem
11	integration: Riemann's approach
12	integration: Darboux's approach
13	integration: Lebesgue's Theorem of Riemann integrability