MATH 3033 (L1 and L2) Real Analysis Course Outline – Fall 2024

1. Instructor

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Office hour: TBA

2. Teaching Assistants

T1A: CHAU, Wai Ming

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Online Meeting Time

Lectures: L1: MoWe 09:00AM - 10:20AM at Rm 5583
L2: TuTh 03:00PM - 04:20PM at Rm 6591

Tutorials: T1A: Tu 07:00PM - 07:50PM at Rm 4579, T1B: Th 12:00PM - 12:50PM at Rm 5583
T2A: Th 12:30PM - 01:20PM at Rm 1034, LSK Bldg, T2B: Th 02:00PM - 02:50PM at Rm 2503

3. Course Description

Credit Points: 4

Pre-requisite: (MATH 2010/ MATH 2011/ MATH 2021/ MATH 2023) AND (MATH 2031/ MATH 2033/ MATH2043) AND (MATH 2111/ MATH 2121/ MATH 2131/ MATH 2350)

Brief Information/synopsis: This course covers basics of set topology, differentiation and inverse function theorems of vector-valued functions, uniform convergence, Lebesgue measure and Lebesgue integral on the real line.

4. Intended Learning Outcomes

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

No.	ILOs
1	Understand logical deduction of important facts in mathematical analysis of high dimension spaces and apply integration theory to solve mathematical and statistical problems.
2	Apply rigorous analytical techniques taught in class to solve problems in convergence frequently appeared in the mathematical profession.

5. Assessment Scheme

a. Examinations: midterm exam (Oct 24) and final exam (date to be announced)
b. Percentage of coursework, examination, etc.:

Assessment	Assessing Course ILOs
5% by class participation	1, 2
10% by Homework	1, 2
30% by midterm exam	1, 2
55% by final exam	1, 2

c. All records of grades will be put on Canvas as soon as they are available. This course is essentially graded by the absolute marks received in the above assessment. This course is essentially graded by the criterion-referencing grading scheme, and grades will not be assigned using a curve. Students should aim at getting a course total of 85% or above for A-/A/A+, and about 60% or above for B-/B/B+. The following are the grade descriptors:

Grade	Short Description	Elaboration on subject grading description
A	Excellent Performance	The student has mastered almost all concepts and techniques of real analysis taught in the course, has excellent understanding of the deepest content of the subject, and acquired workable knowledge for further studies of functional analysis, measure theory, partial differential equations, and related fields.
B	Good Performance	The student has mastered most computational techniques of real 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 computational 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 computations.
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 computations.

d. Students should submit homework to Canvas before deadline.
e. If you are absent from the midterm due to sickness with a valid proof, the weight of your scores will be shifted to final, i.e. 85% Final, 0% Midterm. Invalid reasons for absence will make your midterm 0 marks.

6. Learning Resources

Major reference: lecture notes/lecture slides prepared by the instructor

Useful references textbook: Principles of Mathematical Analysis, by Walter Rudin, 3nd. Edition

All course related materials will be available on Canvas, all the course related announcements will be made on Canvas. RVC lecture video will be posted on Canvas after every lecture.

7. Learning Activities

Lectures: The instructor will focus on illustrating the concepts, the main theorems and the essential math ideas of the course.

Tutorials: TA will focus on examples and problem-solving skills.

8. Homework and Class Participation

Homework: A set of problems for each chapter will be assigned on canvas with specified due date. Students should submit each homework in pdf format on the Canvas system before the due date. No late homework is accepted. You can form a group of at most three students to work on the homework together, and submit one copy of the homework as a team. All team members in the same group will receive the same score.

Class participation: Classwork assignments will be given through Google Classroom during the lesson and each student need to do them to get the class participation marks. The assessment scheme is as follows:

Class participation marks (Total 5%)	Participated in x% of the classwork assignments in Google Classroom
5%	$x \geq 70$
4%	$70 > x \geq 60$
3%	$60 > x \geq 50$
2%	$50 > x \geq 40$
1%	$40 > x \geq 20$
0%	$20 > x$

"Participating in a classwork assignment" does not mean that you must get the correct answer to all the problems in the assignment. But you do need to show some evidence of your effort to attempt the problems in your submitted answers.

9. 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.

10. Course Schedule (Tentative)

Key word Syllabus

- Point-Set Topology (2 weeks)

  The metric in R^n, open sets, closed sets, structure theorem of open set in the real line, compact sets.

- Vector-valued Functions (4 weeks)

  Review on linear transformations in R^n; Continuity and differentiation of vector-valued functions; mean-value inequality, Contraction mapping theorem, the inverse function theorem, the implicit function theorems.

- Sequences and Series of Functions (3 weeks)

  Convergence of sequence, uniform convergence of series of functions; continuity, integration, and differentiation theorem for function series.

- Lebesgue Integration (4 weeks)

  Lebesgue measure on the real line, Lebesgue integral; Convergence theorems.