

## COURSE OUTLINE: MH3100-MH310S

Course Title	<b>Real Analysis I</b>		
Course Code	<b>MH3100-MH310S</b>		
Offered	Study Year 2, Semester 2		
Course Coordinator	Chua Chek Beng (Assoc Prof)	cbchua@ntu.edu.sg	6513 7467
Pre-requisites	{MH1100, MH1101} OR {CY1601} OR {MH1802}		
Mutually exclusive	MH310S		
AU	4		
Contact hours	Lectures: 39, Tutorials: 12		
Approved for delivery from	AY 2022/23 semester 2		
Last revised	28 Nov 2022, 22:26		

### Course Aims

This is the first of two courses on real analysis. This course is compulsory for students of mathematical sciences, and it is a prescribed elective course for students from other schools as well. The course aims to present a careful treatment of the principal topics of calculus I and Calculus II, such as real numbers, basic topology of the real line, sequences and series of numbers and of functions, and to illustrate the power of the subject through a variety of applications. After learning this course, you will be able to understand better many results from Calculus I and II which you studied without proofs.

### Intended Learning Outcomes

Upon successfully completing this course, you should be able to:

1. Explain the abstract notions of the concepts to demonstrate understanding
2. Prove rigorously the mathematical statements in MH1100 and MH1101
3. Apply methods of Real Analysis to solve problems in science and engineering involving real structures.

### Course Content

The real numbers

Sequences and series

Basic topology of the real numbers

Functional limits and continuity

Derivatives

Sequences and series of functions

## Assessment

Component	Course ILOs tested	SPMS-MAS Graduate Attributes tested	Weighting	Team / Individual	Assessment Rubrics
<b>Continuous Assessment</b>					
<b>Technology-enhanced Learning</b>					
Online quiz 1	1	1. a	8	individual	See Appendix for rubric
Online quiz 2	1	1. a	8	individual	See Appendix for rubric
Online quiz 3	1	1. a	8	individual	See Appendix for rubric
<b>Mid-semester Quiz</b>					
Midterm test	1, 2, 3	1. a, b, c 2. a, b, c, d 3. a	26	individual	See Appendix for rubric
<b>Examination (2 hours)</b>					
Final Examination	1, 2, 3	1. a, b, c 2. a, b, c, d 3. a	50	individual	See Appendix for rubric
<b>Total</b>			<b>100%</b>		

These are the relevant SPMS-MAS Graduate Attributes.

### 1. Competence

- a. Independently process and interpret mathematical theories and methodologies, and apply them to solve problems
- b. Formulate mathematical statements precisely using rigorous mathematical language
- c. Discover patterns by abstraction from examples

### 2. Creativity

- a. Critically assess the applicability of mathematical tools in the workplace
- b. Build on the connection between subfields of mathematics to tackle new problems
- c. Develop new applications of existing techniques
- d. Critically analyse data from a multitude of sources

### 3. Communication

- a. Present mathematics ideas logically and coherently at the appropriate level for the intended audience

## Formative Feedback

Feedback will be given to students through the weekly problem tutorial sets that are covered in tutorial. Common mistakes in the midterm test will be discussed in the provided solution sets.

## Learning and Teaching Approach

<b>Lectures</b> (39 hours)	Examples and Explanation - Motivates the concepts in the learning objectives through examples. The general theory and principles are then explained. This also introduces more abstract mathematical reasoning.  Problem solving - Develops competence in solving a variety of problems and gaining familiarity with mathematical proofs.
<b>Tutorials</b> (12 hours)	Examples and Explanation - Motivates the concepts in the learning objectives through examples. The general theory and principles are then explained. This also introduces more abstract mathematical reasoning.  Problem solving - Develops competence in solving a variety of problems and gaining familiarity with mathematical proofs.  Peer Instruction - You will work together to gain experience in explaining concepts to others and presenting solutions.

## Reading and References

\* Textbook

Stephen Abbott: Understanding Analysis, Springer, New York, Second Edition, 2015.  
ISBN 978-1-4939-2711-1, ISBN 978-1-4939-2712-8

\* Reference-book

Robert G. Bartle and Donald R. Sherbert: Introduction to Real Analysis, John Wiley & Sons, 2011.  
ISBN 978-0-471-43331-6

## Course Policies and Student Responsibilities

Advice for students:

- 1.This course is not like Calculus I and II, so get with it from the start or you'll have great difficulty later
- 2.The more you work in January, the less you have to worry in April
- 3.Ask questions and consult with your classmates
- 4.Do the assigned questions and go to the tutorial sessions
- 5.Review your notes before coming to class and make sure you understand the last lecture
- 6.Summarize the theorems in your own words
- 7.Don't wait until the last moment to start studying or to start the suggested exercises

Assessments:

- 1.A late submission of assignments is not accepted
- 2.A student who is absent from midterm without valid Leave of Absence will be given zero mark
- 3.No make-up midterm will be arranged
- 4.In case of a valid reason for absence, the total course marks would subsequently be rescaled to a base of 100%

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult

your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [Academic Integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

## Course Instructors

Instructor	Office Location	Phone	Email
Chua Chek Beng (Assoc Prof)	SPMS-MAS-05-21	6513 7467	cbchua@ntu.edu.sg

## Planned Weekly Schedule

Week	Topic	Course ILO	Readings/ Activities
1	The real numbers	1, 2, 3	Annotated lecture slides
2	The real numbers	1, 2, 3	Annotated lecture slides
3	Sequences and series	1, 2, 3	Annotated lecture slides
4	Sequences and series	1, 2, 3	Annotated lecture slides
5	Sequences and series	1, 2, 3	Annotated lecture slides
6	Basic topology of the real numbers	1, 2, 3	Annotated lecture slides
7	Basic topology of the real numbers	1, 2, 3	Annotated lecture slides
8	Functional limits and continuity	1, 2, 3	Annotated lecture slides Midterm test
9	Functional limits and continuity	1, 2, 3	Annotated lecture slides
10	Derivatives	1, 2, 3	Annotated lecture slides
11	Sequences and series of functions	1, 2, 3	Annotated lecture slides
12	Sequences and series of functions	1, 2, 3	Annotated lecture slides
13	Revision	1, 2, 3	Annotated lecture slides

## Appendix 1: Assessment Rubrics

### Rubric for Technology-enhanced Learning: Online quiz 1 (8%)

Point-based marking (not rubrics based)

### Rubric for Technology-enhanced Learning: Online quiz 2 (8%)

Point-based marking (not rubrics based)

### Rubric for Technology-enhanced Learning: Online quiz 3 (8%)

Point-based marking (not rubrics based)

**Rubric for Mid-semester Quiz: Midterm test (26%)**

Point-based marking (not rubrics based)

**Rubric for Examination: Final Examination (50%)**

Point-based marking (not rubrics based)