Real Analysis

Session: 2025-2026 Autumn term

Lecturer: Dr. Lianghai Xiao

**Materials:** [**https://github.com/styluck/RA**](https://github.com/styluck/RA)

This module introduces the fundamentals that deals with the limits, continuity, derivatives, integrals, and infinite series. It forms the foundation of many other areas of mathematics and its applications in physics, engineering, economics, and more.

This course consists of 36 hours of lectures including 5 hours of example classes.

3 hour-Examination (covering both theory with proofs and problem solving): 80%  
Continuous assessment (homework): 20%

Syllabus

Real Numbers and Set theory: Real Numbers: The completeness of the real number system, ordering, and the least upper bound (supremum) and greatest lower bound (infimum) properties. Set Theory deals with collections of objects, including unions, intersections, subsets, and the cardinality of sets.

The Function and its Properties: The function is a relation between two sets that assigns to every element of the first set (called the domain) exactly one element of the second set (called the codomain). The key properties of the function include Domain, Codomain, Range, Injective, Surjective, and Bijective, etc.

Limits and Continuity: Limits of Functions: Fundamental concepts such as epsilon-delta definitions, and one-sided limits. Continuity: Properties of continuous functions, including the Intermediate Value Theorem, Extreme Value Theorem, and uniform continuity.

Sequences and Series: Convergence of sequences, limits, and properties of converging sequences like boundedness and monotonicity.

Differentiation: The definition and interpretation of the derivative as a rate of change or slope of the tangent line. Chain rule, product rule, quotient rule. Mean Value Theorem: A cornerstone of differential calculus that connects the derivative and the behavior of functions.

Module Outcomes:

1.       Understanding of Fundamental Concepts: Limits and Continuity, Differentiation and Integration, Sequences and Series, etc;

2.       Familiarity with Real Numbers and Metric Spaces;

3.       Prove properties of continuous and differentiable functions using the definitions;

 References:

*"Principles of Mathematical Analysis"* by Walter Rudin

*"Introduction to Real Analysis"* by Robert G. Bartle and Donald R. Sherbert

For any questions, students are encouraged to contact the lecturer by email:

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