

REAL ANALYSIS

The aim of the course is to formalize the Mathematics of Calculus by providing the proper fundamental definitions and rigorous proofs involving infinite processes. The Calculus invented by Newton and Leibnitz in the seventeenth century was sloppy, although most of their results were correct, the proofs they provided were non-rigorous and defective. The arithmetization and rigorization of the underlying deep notions of calculus was started in the late nineteenth century by the great French mathematician A.L.Cauchy who provided the fundamental insights related to the deep notions of limits and continuity. The entire edifice of calculus rested on the basic notion of real numbers. For two thousand five hundred years no one knew the answer to the question "what is a real number?" This question was finally answered in the late 19th century by three pre-eminent German mathematicians Dedekind, Cantor, and Weirstrass, and in same century the outstanding German mathematician Riemann provided the proper formulation of the integral calculus based on Cauchy's deep ideas. All this great effort gave birth to the profound mathematical discipline called Real Analysis (or Mathematical Analysis, or just simply Analysis). Topics marked with * will be covered if time permits.

Topics:

- 1) Mathematical Logic & Proofs
- 2) The Axiomatic Structure of the Real Number System: Some Metrical and Topological Notions. Distance, Open/Closed Sets, Neighbourhoods and Deleted Neighbourhoods, Frontier of a Set, Limit Points, Limits of Real Sequences, Infinite Series & Some Theorems on Series.
- 3) The ϵ - δ Definitions of Limits of Functions: Continuity & Continuous Functions
- 4) Differentiation: The Notion of Derivative. The Important Theorems of Differential Calculus and their Proofs & Applications
- 5) Functions defined by Power Series*.
- 6) Integration: The Fundamental Concept of the Riemann Integral. The Important Theorems of Integral Calculus and their Proofs & Applications
- 7) Functions of Several Variables*: Limits, Continuity, Differentiability and Integrability of Functions of Several Variables*. Power Series*. The Chain Rule*. Inverse & Implicit Function Theorem*. Multiple Integrals & Fubini's Theorem*.

Marking Scheme:

Quiz & Assignment: 10%

Term Exams:30%

Final Exam:60%

Office Hours: (Main Campus) Monday & Wednesday : 10 30am-to-11 30 am.

(City Campus) Tuesday & Thursday: 10 30 am – 12 pm

References:

- 1) An Introduction to Analysis by Arthur Mattuck: Publishers Prentice-Hall 1999.
- 2) Mathematical Analysis by David SG Stirling. Publishers: Woodhouse 2011.
- 3) A First Course in Mathematical Analysis by Burkhil & Burkhil. Publishers: Cambridge University Press 1991.
- 4) A Course of Pure Mathematics by GH Hardy, Publishers: Cambridge University Press 1922.