MATHEMATICAL ANALYSIS 1
SYLLABUS & IMPORTANT THEOREMS

- Elements of logic
  - Proof by induction
  - Proof by contradiction
- Functions
  - Injectivity, surjectivity, invertibility
  - Monotonicity (also of sequences)
  - The elementary functions
- Sequences
  - Subsequences, The **Bolzano-Weierstrass Theorem**
- Complex numbers
- Limits
  - The number e
  - Asymptotes
  - The $\varepsilon - \delta$ formalism
  - Continuity and types of discontinuities
  - Left and right limits
  - Algebra of limits
  - Indeterminate ("meaningless") limits
  - Comparison theorems
- Asymptotic behavior of functions
  - Landau symbols
  - Order of a function, principal part
- Continuous functions on intervals
  - **Bolzano's Theorem** (existence of zeroes)
  - **Intermediate Value Theorem**
  - **Weierstrass' Theorem**
  - Uniform continuity and Lipschitz
  - **Heine-Cantor Theorem**
  - Invertibility
- The derivative
  - Definition and rule
  - **Theorems of Fermat, Rolle, Largrange, Cauchy**
  - Higher-order derivatives
  - Convexity and inflection points
  - Qualitative study of a function
  - **De l'Hôpital's Theorem**
- Taylor and Maclaurin expansions
  - Expansions of the elementary functions
  - **Peano** and **Lagrange remainders**
  - Local behavior of a function via its expansion
- The integral
  - Antiderivatives and indefinite integrals
  - Rules, **integration by parts**, **integration by substitution**
  - Definite integrals, **Cauchy integral**, **Riemann integral**
  - Integral mean value
  - **Fundamental Theorem of Integral Calculus**

  - Integrals with functional limits
- Improper integrals and series
  - Improper integrals of type I
  - Improper integrals of type II
  - Improper integrals convergence tests
  - Series, geometric series
  - Series convergence tests