

General introduction

Analysis 02 is a fundamental course in mathematics that builds on the concepts developed in introductory calculus. It focuses on two major pillars: **integration theory** and **differential equations**, which play a central role in both pure and applied mathematics.

The first part of the course is devoted to **indefinite and definite integrals**.

The **indefinite integral** is introduced as the inverse operation of differentiation, allowing us to determine families of functions whose derivative is known. Various techniques of integration are studied, such as substitution, integration by parts, and partial fractions, which are essential for handling complex functions.

The **definite integral** extends this concept by assigning a numerical value that represents quantities such as area under a curve, accumulated change, or total mass. This leads to the **Fundamental Theorem of Calculus**, which establishes a deep connection between differentiation and integration, forming one of the cornerstones of mathematical analysis.

The second part of the course focuses on **differential equations**, particularly **first-order and second-order linear differential equations with constant coefficients**.

These equations are used to model a wide range of natural and physical phenomena, including population growth, heat transfer, electrical circuits, and mechanical vibrations.

For **first-order differential equations**, methods such as separation of variables and integrating factors are introduced to obtain explicit solutions. For **second-order linear differential equations with constant coefficients**, the solution is based on solving the associated characteristic equation. Depending on the nature of its roots (real distinct, repeated, or complex), different forms of the general solution are obtained.

Overall, Analysis 02 provides essential analytical tools and problem-solving techniques that are indispensable in advanced mathematics, physics, engineering, and other scientific disciplines. It develops both theoretical understanding and practical skills in modeling and solving real-world problems.