

ROWAN UNIVERSITY
Department of Mathematics

Master Syllabus

MATH 01.130 – Calculus I

CATALOGUE DESCRIPTION:

Calculus is a subject about functions. This course primarily deals with the two most fundamental concepts in Calculus: derivatives and definite integrals. It begins with a discussion of the notions of the limit and continuity of a function. Then the definition of a derivative is introduced, and techniques of computing derivatives are studied. Through its applications to analysis of functions, optimizations, and problems in sciences, a student can appreciate the importance of the derivative. The concept of a definite integral as a limit of approximating sums emerges in the context of the area under a curve. Hidden links between those two concepts are formulated in the Fundamental Theorems of Calculus, which also provides a convenient shortcut for computing definite integrals. Emphasis of this course is on intuitive understanding of the two concepts through meaningful examples and applications. A graphing calculator is required for this course, and so is the use of computer software, such as Mathematica.

OBJECTIVES:

Students will demonstrate:

- An intuitive understanding of limits and the ability to compute and approximate limits numerically, geometrically, and algebraically.
- An understanding of interpretations of the derivative in the contexts of geometry, physics, and mathematics.
- The ability to use the derivative rules and formulas to find derivatives of functions built from power, trigonometric, exponential, and logarithmic functions.
- The ability to use differentiation in applications including but not limited to related rates, optimization, and the analysis of graphs and functions.
- An intuitive understanding of the definite integral and its relation to Riemann sums.
- The ability to compute the definite integral of a simple function relying on the Fundamental Theorem of Calculus.
- The ability to express the area between two curves using definite integrals.

PREREQUISITES:

Minimum C- in Math 01.122 (Pre-Calculus), or in Math 01.124 (Reasoning with Functions) and Math 01.125 (Trigonometry), or appropriate placement test scores.

CONTENT:

- A Brief Review of Functions and Their Graphs
- Limits and Continuity
 - Finding left-, right-, and two-sided limits from a graph
 - Estimating limits from a table of values
 - Evaluating limits using algebraic methods, including the “factor-and-cancel” method and multiplication by a conjugate to eliminate a square root for indeterminate forms
 - Evaluating limits using the Squeeze Theorem and using standard trigonometric limits
 - Evaluating limits at infinity
 - Definition of continuity and graphical interpretation
 - Classifying discontinuities, including removable, jump, and infinite
 - L’Hôpital’s Rule (to be taught once students know differentiation techniques)
- Derivatives
 - The definition of a derivative and its geometric, physical, and mathematical meanings
 - The differentiation rules, including the constant multiple, power, sum and difference, product, quotient, and chain rules
 - Finding derivatives of trigonometric, exponential, and logarithmic functions
 - The derivative of an inverse function, including the inverse trigonometric functions $\arctan(x)$ and $\arcsin(x)$
 - Implicit differentiation
- Analysis of Functions and Their Graphs
 - Monotone properties and their relations to the first derivative
 - Concavity and its relation to the second derivative
 - Relative extrema and the first and second derivative tests
 - Rolle’s Theorem and the Mean Value Theorem
- Applications of Derivatives
 - Related rates
 - The Extreme Value Theorem and optimization
 - Linear motions and functions describing position, distance, velocity, and acceleration
- Definite Integrals
 - Building Riemann sums and translating them into definite integrals
 - Computing a definite integral by the definition
 - The Fundamental Theorem of Calculus (Parts 1 and 2)
 - Evaluation of definite integrals with the Fundamental Theorem
 - Basic integral formulas, including power, trigonometric, exponential, and logarithmic functions
 - u -substitution
- Applications of Definite Integrals
 - Area between two curves

REMARK: It is suggested to touch upon the history of Calculus through the biographies of the great mathematicians who made significant contributions to its development.

SUGGESTED TEXTS:

Rogawski, J., Adams, C. & Franzosa, R. CALCULUS: EARLY TRANSCENDENTALS, 4th Edition, 2019, Macmillan.

Strang, G., & Herman, E. CALCULUS VOLUME 1 by OpenStax, 1st Edition, 2016.

<https://openstax.org/books/calculus-volume-1>

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