ROWAN UNIVERSITY
Department of Mathematics

Syllabus
Math 01.130 - Calculus I

CATALOG DESCRIPTION:

Math 01.130 Calculus I, 4 s.h.

Prerequisites: minimum C- in Math 01.122 (Pre-Calculus), or in Math 01.124 (Reasoning with Functions) and Math 01.125 (Trigonometry), or 60 on CLM exam, or 60 on CLM re-test, or 600 on SAT, or 27 on ACT Math.

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 provide 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 First Fundamental Theorem of Calculus.
- The ability to express the area between two curves using definite integrals.

CONTENT:

1. **A brief review of functions and their graphs**

1. **Limits and Continuity**

   It is recommended that the emphasis be placed on the basic understanding through examples, though formal delta and epsilon proofs should be demonstrated when appropriate.

3. **Derivatives**

   - The definition of a derivative, and its geometric, physical and mathematical meanings

- The differentiation rules, and the derivative formulas for power functions, trigonometric function, exponential functions and logarithmic functions
- The derivative of the inverse function
- Implicit differentiation
- Related rates

4. **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 2nd derivative tests
- Rolle's Theorem and the Mean Value Theorem

5. **Applications of Derivatives**

- The extreme value theorem and optimization
- Linear motions and functions describing position, distance, velocity and acceleration

6. **Definite Integrals**

- Riemann sums and definite integrals
- Computing a definite integral by the definition
- The Fundamental Theorems of Calculus
- Evaluation of definite integrals by the first Fundamental Theorem
- Basic integral formulas and u-substitution

7. **Applications of Definite Integrals**

- Areas between two curves

REMARKS: In each chapter we will touch upon the history of Calculus through the biographies of the great mathematicians who made significant contributions to its development. In addition, we will begin to learn to use Mathematica as a tool.

TEXTBOOK(s):

Textbook used:

- Rogawski, Jon; Colin Adams; Robert Franzosa, CALCULUS: EARLY TRANSCENDENTALS (4th Edition*), 2019, Freeman.

Additional textbooks:

- Stewart, James, CALCULUS: EARLY TRANSCENDENTALS (8th Edition), 2016, Cengage Learning.

(Note: There are many texts that cover the same material at a suitable level, such as those by Anton, Larson, Thomas, Stein, Hunt and Leithold).