

# Common Course Outline

## MATH 251

### Calculus I

4 Credits

## Community College of Baltimore County

### Description

**Math 251 – Calculus I** covers functions (including: logarithmic, exponential, inverse, inverse trigonometric, and hyperbolic), limits, continuity, derivatives, derivative algorithms, linear approximations, optimization and other applications, area under a curve, definite integrals, the Fundamental Theorem of Calculus, Mean Value Theorem, Rolle’s Theorem, and Intermediate Value Theorem.

**4 Credits:** 5 lecture hours

**Prerequisite:** Math 165 with a grade of “C” or better or equivalent satisfactory score on the placement test

### Overall Course Objectives

Upon completion of this course students will be able to:

1. evaluate limits of functions;
2. determine continuity and differentiability;
3. sketch the graph of the derivative function given the graph of the original function;
4. determine the derivative of a function from its definition;
5. determine the derivative of a function by rules;
6. sketch a function, using appropriate information (increasing/decreasing functions, concavity, max/min points, points of inflection);
7. determine optimal values (extrema);
8. apply the following theorems: Mean Value Theorem, Rolle’s Theorem, and Intermediate Value Theorem;
9. determine the area under a curve using Riemann sums;
10. evaluate definite integrals using the Fundamental Theorem of Calculus and change of variables;
11. examine the mathematical contributions made by people from diverse cultures throughout history and their cultural and social significance;
12. articulate a solution to mathematical problems;
13. apply appropriate technology to the solution of mathematical problems and their applications, accurately and ethically;
14. determine antiderivatives algebraically, graphically, and numerically;
15. apply the Second Fundamental Theorem of Calculus;

16. use Newton's method to solve transcendental equations;
17. use numerical integration techniques to approximately evaluate a definite integral; and
18. find, evaluate, use, and cite appropriate academic resources when completing their written assignments.

## **Major Topics**

- I. Precalculus review
  - A. Functions (definition, domain and range)
  - B. New Functions from old (transformations, composition)
  - C. Trigonometric functions
- II. Limits and continuity
  - A. The epsilon-delta definition of a limit, intuitive, numerical, graphical and algebraic, left-limits and right-limits.
  - B. Limits for trigonometric functions
  - C. Techniques for computing limits
  - D. Definition of continuity
  - E. Intermediate Value Theorem
- III. Introduction to the Derivative
  - A. Tangent line and Rate of Change
  - B. Definition of the derivative at a point and the derivative function
  - C. Differentiability
  - D. Second derivative as concavity and higher order derivatives
  - E. Rolle's Theorem and Mean Value Theorem
- IV. Rules of Differentiation
  - A. Derivative rules (constant, scalar multiple, sum, product and quotient)
  - B. Derivative of polynomial, trigonometric and other special functions
  - C. The Chain Rule
  - D. Implicit differentiation
- V. Using the Derivative
  - A. Linear approximation and differentials
  - B. Critical points, extrema and inflection points
  - C. First and Second Derivative Tests
  - D. Curve sketching
  - E. Motion on a straight line (position, velocity and acceleration functions)
  - F. Optimization problems
  - G. Related rates
  - H. Newton's Method
  - I. Global and ethical issues and topics analyzed through the application of derivatives and related rates
- VI. Indefinite Integral
  - A. Antiderivatives and how to compute them algebraically, graphically, and numerically
  - B. Definition of the Indefinite Integral
  - C. Integral of basic functions
  - D. Solving Indefinite Integrals by a Change in Variables

## VII. Definite Integral

- A. Intuitive notion of a definite integral as area under a curve
- B. Definition of the definite integral as a Riemann sums
- C. Computation of Riemann sums (lower, upper, right, left and midpoint)
- D. Estimating the area under a curve using Riemann sums.
- E. Evaluate definite integrals using the Fundamental Theorem of Calculus
- F. Numerical integration (Trapezoidal, and Simpson's) with error bounds

## VIII. Inverse Functions, Logarithmic, Exponential and other functions

- A. The natural logarithmic function
- B. Inverse functions
- C. The exponential function and the social/global topics analyzed by them
- D. Inverse trigonometric functions
- E. Hyperbolic functions

### **Course Requirements**

Grading procedures will be determined by the individual faculty member but will at least include the following:

### **Grading/exams**

- At least two tests will be given. Individual faculty will notify students of the testing procedures to be used.
- Written Project(s) (10% of the overall course grade)

Written Assignments: Students are required to use appropriate academic resources. Students are required to utilize appropriate academic resources. At least one assignment worth a minimum of 10% of the total course will allow students to demonstrate at least 5 of the 7 General Education Program outcomes.

### **Other Course Information**

This course is an approved 4-credit General Education course in the Mathematics category. Please refer to the current CCBC Catalog for General Education course criteria and outcomes.