

# Common Course Outline

## MATH 251

### Calculus I

4 Semester Hours

## The Community College of Baltimore County

### Description

Topics include 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, Intermediate Value Theorem. Prerequisites are Math 165 or equivalent satisfactory score on the placement test.

### Overall Course Objectives

Upon successfully completing the course students will be able to:

1. Evaluate limits of functions (I, IV, VI, 1,5)
2. Determine continuity and differentiability (I, III, 1,2,3,7)
3. Sketch the graph of the derivative function given the graph of the original function (IV, 1, 3)
4. Determine the derivative of a function from its definition (VI, IV, 1, 3, 7)
5. Determine the derivative of a function by rules (II, 1,6)
6. Sketch a function, using appropriate information (increasing/decreasing functions, concavity, max/min points, points of inflection) (IV, II, 1,3)
7. Determine optimal values (extrema) (IV, V, 1, 3)
8. Apply the following theorems: Mean Value Theorem, Rolle's Theorem, and Intermediate Value Theorem (V, 1, 2, 4)
9. Determine the area under a curve using Riemann sums (IV, 1, 2, 3)
10. Evaluate definite integrals using the Fundamental Theorem of Calculus and change of variables (IV, 1, 2, 4)
11. [Examine the mathematical contributions made by people from diverse cultures throughout history.](#) (V, 5)
12. [Articulate a solution to mathematical problems.](#) (II, 2)
13. Apply appropriate technology to the solution of mathematical problems. (IV, 4, 5).
14. Determine antiderivatives algebraically, graphically, and numerically (II, IV, 1, 2, 5)
15. Apply the Second Fundamental Theorem of Calculus (I, V, 1, 4)

### 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 idea of a limit:  $\epsilon$  &  $\delta$ , intuitive, numerical, graphical and algebraic
  - B. Limits for trigonometric functions.

- C. Techniques for computing limits (indeterminate forms  $0/0$ ,  $\infty/\infty$ ,  $\infty-\infty$ )
- 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

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. Area between two curves
- G. Total distance traveled

VIII. Inverse Functions, Logarithmic, Exponential and other functions

- A. The natural logarithmic function
- B. Inverse functions
- C. The exponential function
- D. Inverse trigonometric functions
- E. Hyperbolic functions

**Course Requirements (General Education Goal #VII)**

Students will be given opportunity to collaborate via group work and/or oral presentation of problem solutions. There will be multiple opportunities for the instructor to assess student progress in the course through classwork and/or homework.

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

Tests, Exams, and/or Quizzes: At least two tests will be given. Individual faculty will notify students of the testing procedures to be used.

Comprehensive Final Exam: The course will include a comprehensive final exam, which may include a final project.

Final Grades: Grades will be determined by individual faculty members.

The Community College of Baltimore County is committed to providing a high-quality learning experience that results in growth in knowledge, attitudes, and skills necessary to function successfully as a transfer student, in a career and as a citizen. To accomplish this goal, we maintain high academic standards and expect students to accept responsibility for their individual growth by attending classes, completing all homework and other assignments, participating in class activities and preparing for tests.

We take seriously our responsibility to maintain high-quality programs and will periodically ask you to participate in assessment activities to determine whether our students are attaining the knowledge, attitudes and skills appropriate to various courses and programs. The assessment activities may take many different forms such as surveys, standardized or faculty-developed tests, discussion groups or portfolio evaluations. We ask that you take these activities seriously so that we can obtain valid data to use for the continuous improvements of CCBC's course and programs.

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