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.

Date revised: 01/30/2019