Atlantic Cape Community College
Mathematics Department

Calculus I – MATH155
Credits: 4-0-4

Course Description and Prerequisite: Completion of Math 128 or Math 150 or equivalent with a grade of C or better or SAT score.

Topics of study include properties of functions and their graphs, properties and applications of limits, techniques of differentiation, applications of differentiation, techniques of integration, applications of integration, differentiation and integration of logarithmic and exponential functions, differentiation and integration of trigonometric and inverse trigonometric functions, applied optimization, differentials, and L'Hopital's Rule.

Students will:

- Understand the concept of a limit through discussion, analysis and application.
- Understand the meaning of the derivative in terms of a rate of change and local linear approximation and the use of derivatives to solve a variety of problems.
- Work with functions represented in a variety of ways: graphical, numerical, analytical, or verbal. They should understand the connections among these representations.
- Understand the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change and the use of integrals to solve a variety of problems.
- Communicate mathematics both orally and in well-written sentences and should be able to communicate solutions to problems, and determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.

Student Learning Outcomes:

Students will be able to:

- Develop the concept of a limit through discussion, analysis, and application.
- Apply limits to explore the concept of a derivative: the mathematical tool used to study rates at which physical quantities change.
- Analyze functions and their graphs using techniques of differentiation.
- Reconstruct a function from its derivative using antidifferentiation.
- Calculate areas of plane regions with curvilinear boundaries.
- Model a written description of a physical situation with a function, a differential equation, or an integral.
- Apply techniques of differentiation and integration to logarithmic and exponential functions.
- Apply knowledge of differentiation and integration techniques to evaluate integrals and limits involving L'Hopital's Rule.

LEARNING OBJECTIVES:

CHAPTER ONE
Limits and Their Properties

1.1: A Preview of Calculus
- Students will be able to demonstrate knowledge of what calculus is and how it compares with precalculus.
- Students will be able to explain the Tangent Line problem.
- Students will be able to explain the area problem.

1.2: Finding Limits Graphically and Numerically
- Students will be able to estimate a limit using a numerical or graphical approach.
- Students will be able to identify different ways that a limit can fail to exist.
- Students will be able to use the formal definition of a limit.

1.3: Evaluating Limits Analytically
- Students will be able to evaluate a limit using properties of limits.
- Students will be able to evaluate a limit using dividing out and rationalizing techniques.
- Students will be able to evaluate a limit using the Squeeze Theorem.
- Students will develop and use a strategy for finding limits.

1.4: Continuity and One-Sided Limits
- Students will be able to determine continuity at a point and continuity on an open interval.
- Students will be able to determine one-sided limits and continuity on a closed interval.
- Students will be able to use properties of continuity.
- Students will be able to demonstrate an understanding of and use the Intermediate Value Theorem.

1.5: Infinite Limits
Students will be able to determine infinite limits from the left and from the right.
Students will be able to find and sketch the vertical asymptotes of the graph of a function.

CHAPTER TWO
Differentiation

2.1: The Derivative and the Tangent Line Problem

- Students will be able to find the slope of the tangent line to a curve at a point.
- Students will be able to use the limit definition to find the derivative of a function.
- Students will be able to demonstrate an understanding of the relationship between differentiability and continuity.

2.2: Basic Differentiation Rules and Rates of Change

- Students will be able to find the derivative of a function using the Constant Rule.
- Students will be able to find the derivative of a function using the Power Rule.
- Students will be able to find the derivative of a function using the Constant Multiple Rule.
- Students will be able to find the derivative of a function using the Sum and Difference Rules.
- Students will be able to find the derivatives of the sine function and of the cosine function.
- Students will be able to use derivatives to find rates of change.

2.3: Product and Quotient Rules and Higher-Order Derivatives

- Students will be able to find the derivative of a function using the Product Rule.
- Students will be able to find the derivative of a function using the Quotient Rule.
- Students will be able to find the derivative of a trigonometric function.
- Students will be able to find a higher-order derivative of a function.

2.4: The Chain Rule

- Students will be able to find the derivative of a composite function using the Chain Rule.
- Students will be able to find the derivative of a function using the General Power Rule.
- Students will be able to simplify the derivative of a function using algebra.
- Students will be able to find the derivative of a trigonometric function using the Chain Rule.

2.5: Implicit Differentiation

- Students will be able to distinguish between functions written in implicit form and explicit form.
- Students will be able to use implicit differentiation to find the derivative of a function.

2.6: Related Rates

- Students will be able to find a related rate.
- Students will be able to demonstrate the ability to use related rates to solve real-life problems.

CHAPTER THREE
Applications of Differentiation

3.1: Extrema on an Interval

- Students will be able to demonstrate an understanding of the definition of extrema of a function on an interval.
- Students will be able to demonstrate an understanding of the definition of relative extrema of a function on an open interval.
- Students will be able to find extrema on a closed interval.

3.2: Rolle's Theorem and the Mean Value Theorem

- Students will be able to demonstrate an understanding of the definition of Rolle's Theorem.
- Students will be able to use Rolle's Theorem.
- Students will be able to demonstrate an understanding of the definition of the Mean Value Theorem.
- Students will be able to use the Mean Value Theorem.

3.3: Increasing and Decreasing Functions and the First Derivative Test

- Students will be able to determine intervals on which a function is increasing or decreasing.
- Students will be able to apply the First Derivative Test to find relative extrema of a function.

3.4: Concavity and the Second Derivative Test

- Students will be able to determine intervals on which a function is concave upward or concave downward.
- Students will be able to find any points of inflection of the graph of a function.
- Students will be able to apply the Second Derivative Test to find relative extrema of a function.

3.5: Limits at Infinity

- Students will be able to determine finite limits at infinity.
- Students will be able to determine the horizontal asymptotes, if any, of the graph of a function.
- Students will be able to determine infinite limits at infinity.

3.6: A Summary of Curve Sketching (Use as a review for Chapter 3)

- Students will be able to analyze and sketch the graph of a function.

3.7: Optimization Problems

- Students will be able to solve applied Optimization Problems (minimum and maximum problems).

CHAPTER FOUR
Integration

4.1: Antiderivatives and Indefinite Integration

- Students will be able to write the general solution of a differential equation.
- Students will be able to use indefinite integral notation for antiderivatives.
- Students will be able to use basic integration rules to find antiderivatives.
- Students will be able to find a particular solution of a differential equation.

4.2: Area (Briefly – see homework for focus)

- Students will be able to use sigma notation to write and evaluate a sum.
- Students will be able to demonstrate an understanding of the concept of area.
- Students will be able to evaluate a sum using the Summation Formulas.
- Students will be able to find the limit of a sum.

4.3: Riemann Sums and Definite Integrals (Briefly – see homework for focus)

- Students will be able to demonstrate an understanding of the definition of a Definite Integral.
- Students will be able to demonstrate an understanding of the definition of a Definite Integral as the Area of a Region.
- Students will be able to find the areas of common geometric figures.
- Students will be able to evaluate a definite integral using properties of definite integrals.

4.4: The Fundamental Theorem of Calculus

- Students will be able to evaluate a definite integral using the Fundamental Theorem of Calculus.
- Students will be able to demonstrate an understanding of the Mean Value Theorem for Integrals.
- Students will be able to use the Mean Value Theorem for Integrals.
- Students will be able to find the average value of a function over a closed interval.
- Students will be able to demonstrate an understanding of the Second Fundamental Theorem of Calculus.
- Students will be able to use the Second Fundamental Theorem of Calculus.
- Students will be able to understand and use the Net Change Theorem.

4.5: Integration by Substitution

- Students will be able to use pattern recognition to find an indefinite integral.
- Students will be able to use a change of variables to find an indefinite integral.
- Students will be able to use the General Power Rule for Integration to find an indefinite integral.
- Students will be able to use a change of variables to evaluate a definite integral.

CHAPTER FIVE
Logarithmic, Exponential and Other Transcendental Functions

5.1: The Natural Logarithmic Functions: Differentiation

- Students will review and be able to use properties of the natural logarithmic function.
- Students will be able to define the number e.
- Students will be able to find derivatives of functions involving the natural logarithmic function.

5.2: The Natural Logarithmic Function: Integration

- Students will be able to use the Log Rule for Integration to integrate a rational function.
- Students will be able to integrate trigonometric functions.

5.4: Exponential Functions: Differentiation and Integration

- Students will review and be able to use properties of the natural exponential function.
- Students will be able to differentiate natural exponential functions.
- Students will be able to integrate natural exponential functions.

5.5 Bases Other than e and Applications

- Students will be able to define exponential functions that have bases other than e
- Students will be able to differentiate and integrate exponential functions that have bases other than e
- Students will be able to use exponential functions to model compound interest and exponential growth

5.6 Indeterminate Forms and L'Hopital's Rule

- Students will be able to recognize limits that produce indeterminate forms
- Students will be able to apply L'Hopital's Rule to evaluate a limit

5.7 Inverse Trigonometric Functions and Differentiation

- Students will be able to develop properties of the six inverse trigonometric functions
- Students will be able to differentiate an inverse trigonometric function

5.8 Inverse Trigonometric Functions and Integration

- Students will be able to integrate functions whose antiderivatives involve inverse trigonometric functions
- Students will be able to use the method of completing the square to integrate a function

ASSESSMENT STRATEGIES:

Student Learning Outcome	Assessment Strategies
• Develop the concept of a limit through discussion, analysis, and application.	• Comprehensive Exam • Classroom Observation
• Apply limits to explore the concept of a derivative: the mathematical tool used to study rates at which physical quantities change.	• Comprehensive Exam • Classroom Observation
• Analyze functions and their graphs using techniques of differentiation.	• Comprehensive Exam • Classroom Observation
• Reconstruct a function from its derivative using antidifferentiation.	• Comprehensive Exam • Classroom Observation
• Calculate areas of plane regions with curvilinear boundaries.	• Comprehensive Exam • Classroom Observation
• Model a written description of a physical situation with a function, a differential equation or an integral.	• Comprehensive Exam • Classroom Observation
• Apply techniques of differentiation and integration to logarithmic and exponential functions.	• Comprehensive Exam • Classroom Observation

College Grading Scale (except for Paralegal, Nursing, and Culinary Programs)

Grade	Percentage Range	Grade Point Value
A	93-100%	4.0
A-	90-92%	3.7
B+	87-89%	3.3
B	83-86%	3.0
B-	80-82%	2.7
C+	77-79%	2.3
C	70-76%	2.0
D	60-69%	1.0

TEXTBOOK AND MATERIALS

- Textbook available online on WebAssign: Calculus Of A Single Variable – 11th edition with the student's solution manual by Larson and Edwards.
- A scientific calculator. The TI-84 Graphing Calculator will be used during classroom demonstrations therefore, the TI-84 is strongly recommended. If you choose a calculator other than the TI-84, it is your responsibility to learn the applications by reading your user manual. You will not be permitted to use any other calculator for testing.

ADA Accommodations

ADA accommodations for disabilities can be provided to students who provide documentation to Atlantic Cape's Disability Support Services (DSS) office. A licensed healthcare professional must provide this documentation and it must be current within the last five years. No accommodations can be provided for a course unless a student is first registered with the DSS office. For more information, please contact Lucy McGlynn (email: lmcglynn@atlantic.edu and/or phone: 609-343-5090.
