straighterline

Syllabus

MAT250 | **Calculus I**

Course Text

This course does not require a text.

Course Description

This course is designed to acquaint students with calculus principles such as derivatives, integrals, limits, approximation, applications and integration, and curve sketching. During this course, students will gain experience in the use of calculus methods and learn how calculus methods may be applied to practical applications. Topics covered include Special Functions, Limits, Derivatives, Computational Techniques, Applications of Differentiations, and Applications of Integration.

Learning Outcomes

After completing this course, students will be able to:

1. Demonstrate the continuity or discontinuity of the function
2. Solve the limit problem by using various Limit laws
3. Demonstrate various rules of derivatives
4. Computer derivatives
5. Demonstrate derivatives for trigonometric, exponential, and logarithmic functions
6. Apply Implicit differentiation
7. Apply L'Hôpital's Rule to find the limit of indeterminate forms
8. Sketch the graphs using the derivatives
9. Compute area between the curves using integration
10. Solve vertical motion problems
11. Illustrate the Fundamental Theorem of Calculus
12. Demonstrate convergence and divergence of improper integrals

Course Prerequisites

Precalculus is a required prerequisite for Calculus I. If you enroll, the assumption is made that you have previously completed Precalculus for credit with a passing score.

Academic Integrity Statement

Academic integrity is the pursuit of scholarly activity in an honest, truthful and responsible manner. Violations of academic integrity include, but are not limited to, plagiarism, cheating, fabrication and academic misconduct. Failure to comply with the Academic Integrity Policy can result in a failure and/or zero on the

attempted assignment/examination, a removal from the course, disqualification to enroll in future courses, and/or revocation of an academic transcript.

Course Completion Policy

In order for a course to be considered complete, **all required coursework must be attempted, submitted, and graded.** Required coursework consists of graded assignments. Any Academic Integrity Policy violations may prevent a course from being considered complete.

Assessment Types

StraighterLine courses may include any combination of the assessment types described below. Review the descriptions to learn about each type, then review the Course Evaluation Criteria to understand how your learning will be measured in this course.

Benchmarks

Benchmarks test your mastery of course concepts. You have 3 attempts, and your highest score counts.
Note: Cumulative Benchmarks (final exams) only allow 1 attempt.

Capstones

Capstones are project-based assessments that help you apply concepts to real-world scenarios. You have 2 attempts, and your highest score counts.

Checkpoints

Checkpoints are quick knowledge checks on important course concepts. All are open-book, and most have 1-3 attempts.

AI Use-Case Policies

StraighterLine Capstone assessments operate under one of three AI Use-Case Policies. These designations are selected intentionally to support learners in developing digital literacy, ethical reasoning, and authentic communication skills. Each model requires students to engage meaningfully with the course outcomes while adhering to academic standards.

Independent Work Requirement: Capstones with this designation must be completed independently without using AI tools. The goal is for learners to showcase their own understanding and skills without AI assistance. Students are expected to generate and submit original work developed solely through their own reasoning and effort.

AI-Assisted Planning Option: Capstones with this designation may allow AI tools to support brainstorming and assessment planning. If allowed, students will be asked to document any AI assistance by noting how it informed their work. Documentation must be included within the assignment or in a designated reflection field. Examples include describing how an AI tool helped organize an outline, generate ideas, or surface sources for further exploration.

AI-Integration Requirement: Capstones with this designation require AI tools as part of the learning process. Students will be asked to reflect upon their AI interactions and AI contributions to the assessment. Reflections must include which tools were used, how they were used, and what insights students gained from the process. This promotes transparency, ethical use, and metacognitive skill-building.

Course Evaluation Criteria

Your score provides a percentage score and letter grade for each course. A passing percentage is 70% or higher.

There are a total of 1000 points in the course:

Assessment	Points	Learning Outcomes
Checkpoint 1: Preliminaries and Functions	0	N/a
Benchmark 1: Checkpoint 1	20	1
Checkpoint 2: Limits and Continuity	0	N/a
Benchmark 2: Checkpoints 1-2	55	1, 2
Checkpoint 3: Derivatives	0	N/a
Benchmark 3: Checkpoints 1-3	100	1-3
Checkpoint 4: Computational Techniques	0	N/a
Benchmark 4: Checkpoint 4	20	4
Checkpoint 5: Implicit Differentiation	0	N/a
Benchmark 5: Checkpoints 4-5	55	4-6
Checkpoint 6: Dealing with Indeterminate Forms	0	N/a
Benchmark 6: Checkpoints 4-6	100	4-7
Checkpoint 7: Applications of Differentiations	0	N/a
Benchmark 7: Checkpoint 7	20	8
Checkpoint 8: Curve Sketching	0	N/a
Benchmark 8: Checkpoints 7-8	55	8-9
Checkpoint 9: Introduction to Integrals	0	N/a
Benchmark 9: Checkpoints 7-9	100	8-9
Checkpoint 10: Applications of Integrals	0	N/a
Benchmark 10: Checkpoint 10	20	10
Checkpoint 11: Techniques of Integration	0	N/a
Benchmark 11: Checkpoints 10-11	55	10-11
Checkpoint 12: Special Functions	0	N/a
Benchmark 12: Checkpoints 10-12	100	10-12
Benchmark 13: Checkpoints 1-12	300	1-12
Total	1000	

Course Roadmap

This roadmap provides an overview of the checkpoints and lessons covered in this course.

Checkpoint 1: Preliminaries and Functions

- Checkpoint 1 Pre-Reading: What Do You Think?
- Welcome to Calculus
- The Two Questions of Calculus
- Average Rates of change
- How to Do Math
- Functions
- Graphing Lines
- Parabolas
- Some Non-Euclidean Geometry

Checkpoint 2: Limits and Continuity

- Checkpoint 2: Pre-Reading: What Do You Think?
- Finding Rate of Change Over an Interval
- Finding Limits Graphically
- The Formal Definition of a Limit
- The Limit Laws, Part I
- The Limit Laws, Part II
- One-Sided Limits
- The Squeeze Theorem
- Continuity and Discontinuity
- Evaluating Limits
- Limits and Indeterminate Forms
- Two Techniques for Evaluating Limits
- An Overview of Limits
- Pathfinder: Limits and Continuity

Checkpoint 3: Derivatives

- Checkpoint 3 Pre-Reading: What Do You Think?
- Rates of Change, Secants, and Tangents
- Finding Instantaneous Velocity
- The Derivative
- Differentiability
- The Slope of a Tangent Line
- Instantaneous Rate
- The Equation of a Tangent Line
- More on Instantaneous Rate
- The Derivative of the Reciprocal Function
- The Derivative of the Square Root Function
- Pathfinder: The Calculus Lab

Checkpoint 4: Computational Techniques

- Checkpoint 4 Pre-Reading: What Do You Think?
  Computational Techniques
- A Shortcut for Finding Derivatives

- A Quick Proof of the Power Rule
- Uses of the Power Rule
- The Product Rule
- The Quotient Rule
- An Introduction to the Chain Rule
- Using the Chain Rule
- Combining Computational Techniques

Checkpoint 5: Implicit Differentiation

- Checkpoint 5: Pre-Reading: What Do You Think?
- An Introduction to Implicit Differentiation
- Finding the Derivative Implicitly
- Using Implicit Differentiation
- Applying Implicit Differentiation

Checkpoint 6: Dealing with Indeterminate Forms

- Checkpoint 6: Pre-Reading: What Do You Think?
- Indeterminate Forms
- An Introduction to L'Hôpital's Rule
- More Exotic Examples of Indeterminate Forms
- L'Hôpital's Rule and Indeterminate Products
- L'Hôpital's Rule and Indeterminate Differences
- L'Hôpital's Rule and One to the Infinite Power
- Another Example of One to the Infinite Power

Checkpoint 7: Applications of Differentiations

- Checkpoint 7: Pre-Reading: What Do You Think?
- Acceleration and the Derivative
- Solving World Problems Involving Distance and Velocity
- Higher-Order Derivatives and Linear Approximation
- Using the Tangent Line Approximation Formula
- Newton's Method
- The Connection Between Slope and Optimization
- The Fence Problem
- The Box Problem
- The Can Problem
- The Wire-Cutting Problem
- The Pebble Problem
- The Ladder Problem
- The Baseball Problem
- The Blimp Problem
- Math Anxiety

Checkpoint 8: Curve Sketching

- Checkpoint 8: Pre-Reading: What Do You Think?
- Curve Sketching
- An Introduction to Curve Sketching
- Three Big Theorems
- Morale Moment
- Critical Points

- Maximum and Minimum
- Regions Where a Function Increases or Decreases
- The First Derivative Tests
- Math Magic
- Concavity and Inflection Points
- Using the Second Derivative to Examine Concavity
- The Mobius Band
- Graphs of Polynomial Functions
- Cusp Points and the Derivative
- Domain-Restricted Functions and the Derivative
- The Second Derivative Test
- Vertical Asymptotes
- Horizontal Asymptotes and Infinite Limits
- Graphic Functions with Asymptotes
- Functions with Asymptotes and Holes
- Functions with Asymptotes and Critical Points

Checkpoint 9: Introduction to Integrals

- Checkpoint 9: Pre-Reading: What Do You Think?
- Antidifferentiation
- Antiderivatives of Power of x
- Antiderivatives of Trigonometric and Exponential Functions
- Undoing the Chain Rule
- Integrating Polynomials by Substitution
- Integrating Composite Trigonometric Functions by Substitution
- Integrating Composite Exponential and Rational Functions by Substitution
- More Integrating Trigonometric Functions by Substitution
- Choosing Effective Function Decompositions
- Approximating Areas of Plane Regions
- Areas, Riemann Sums, and Definite Integrals
- The Fundamental Theorem of Calculus Part I
- The Fundamental Theorem of Calculus Part II
- Illustrating the Fundamental Theorem of Calculus
- Evaluating Definite Integrals

Checkpoint 10: Application of Integrals

- Checkpoint 10: Pre-Reading: What Do You Think?
- Antiderivatives and Motion
- Gravity and Vertical Motion
- Solving Vertical Motion Problems
- The Area Between Two Curves
- Limits of Integration and Area
- Common Mistakes to Avoid When Finding Areas
- Regions Bound by Several Curves
- Finding Areas by Integrating with Respect to y: Part One
- Finding Areas by Integrating with Respect to. y: Part Two
- Area, Integration by Substitution, and Trigonometry
- Pathfinder: Curve Sketching

Checkpoint 11: Techniques of Integration

- Checkpoint 11: Pre-Reading: What Do You Think?

- Finding Partial Fraction Decompositions
- Partial Fractions
- Long Division
- An Introduction to Integration by Parts
- Applying Integration by Parts to the Natural Log Function
- Inspirational Examples of Integration by Parts
- Repeated Application of Integration by Parts
- Algebraic Manipulation and Integration by Parts

Checkpoint 12: Special Functions

- Checkpoint 12: Pre-Reading: What Do You Think?
- A Review of Trigonometry
- Graphing Trigonometric Functions
- The Derivatives of Trigonometric Functions
- The Number Pi
- Graphing Exponential Functions
- Derivatives of Exponential Functions
- The Music of Math
- Evaluating Logarithmic Functions
- The Derivative of the Natural Log Function
- Using the Derivative Rules with Transcendental Functions
- The Exponential and Natural Log Functions
- Differentiating Logarithmic Functions
- Logarithmic Differentiation
- The Basics of Inverse Functions
- Finding the Inverse of a Function
- The Inverse Sine, Cosine, and Tangent Functions
- The Inverse Secant, Cosecant, and Cotangent Functions
- Evaluating Inverse Trigonometric Function
- Derivatives of Inverse Trigonometric Functions
- More Calculus of Inverse Trigonometric Functions
- Defining the Hyperbolic Functions
- Hyperbolic Identities
- Derivatives of Hyperbolic Functions

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