

# Fariborz Maseeh Department of Mathematics and Statistics

MTH 251: Calculus I

Updated Fall 2021

**Course Description:** Differential calculus of functions of a single variable, including limits, the definition and computation of the derivative, and applications of the derivative. This is the first course in a sequence of three: Mth 251, Mth 252, and Mth 253, which must be taken in sequence.

### Credits: 4

**Prerequisites:** Completion of Mth 112 with a grade of C- or above within the last year, or passing at the necessary level on the mathematics placement test within the last year (https://www.pdx.edu/math/placement).

**Course Objectives:** The course focuses on the basic differential calculus of real-valued functions of a single variable. This includes limits, continuity, derivatives and applications of derivatives.

Student Learning Outcomes: Upon completion of this course students will be able to:

- Evaluate limits graphically, numerically, and symbolically.
- Analyze and describe functions with respect to continuity, asymptotes, and extreme values.
- Understand and apply the definition of the derivative, and be able to find derivatives using both this definition and the traditional differentiation rules.
- Recognize limits and derivatives in various settings and be able to use correct mathematical terminology, notation, and symbolic processes to meaningfully communicate mathematics accurately with others.
- Understand the basic relationships between functional behavior and associated properties of the first and second derivatives, including monotonicity and the Mean Value Theorem.
- Model and solve several types of applications using derivatives and linear approximations.
- Find indeterminate limits using L'Hôpital's Rule.
- Use implicit differentiation and apply these techniques to situations and applications involving related rates.



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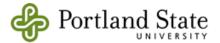
• Use the basic techniques of optimization and creatively apply these techniques to locate maxima and minima in applied contexts.

# Topics:

- 1. *Limits and Continuity*: Understanding limits numerically, graphically, and algebraically, basic limit laws, continuity, trigonometric limits, limits at infinity, intermediate value theorem.
- 2. *Differentiation:* Definition of derivative, rates of change, product rule, quotient rule, chain rule, implicit differentiation, related rates, higher derivatives, derivatives of trigonometric functions, exponential functions, logarithmic functions.
- 3. *Applications of Differentiation:* Finding maxima/minima, applied optimization, mean value theorem, monotonicity, graph sketching, L'Hôpital's Rule, Newton's method, linear approximation.

### Textbook:

Jon Rogawski, Colin Adams, and Robert Franzosa *Calculus: Early Transcendentals*, 4th ed., Freeman, W.H.& Company 2019.



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# MTH 251 Textbook Mapping:

Jon Rogawski, Colin Adams, and Robert Franzosa *Calculus: Early Transcendentals*, 4th ed., Freeman, W.H.& Company 2019.

The course uses an online homework system from Edfinity Courseware

#### 1 Precalculus Review

1.1 Real Numbers, Functions, and Graphs

#### 2 Limits

- 2.1 The Limit Idea: Instantaneous Velocity and Tangent Lines
- 2.2 Investigating Limits
- 2.3 Basic Limit Laws
- 2.4 Limits and Continuity
- 2.5 Indeterminate Forms
- 2.6 The Squeeze Theorem and Trigonometric Limits
- 2.7 Limits at Infinity
- 2.8 Intermediate Value Theorem

### 3 Differentiation

- 3.1 Definition of the Derivative
- 3.2 The Derivative as a Function
- 3.3 Product and Quotient Rules
- 3.4 Rates of Change
- 3.5 Higher Derivatives
- 3.6 Trigonometric Functions
- 3.7 The Chain Rule
- 3.8 Implicit Differentiation
- 3.9 Derivatives of General Exponential and Logarithmic Functions
- 3.10 Related Rates

#### 4 Applications of the Derivative

- 4.1 Linear Approximation and Applications
- 4.2 Extreme Values
- 4.3 The Mean Value Theorem and Monotonicity
- 4.4 The Second Derivative and Concavity
- 4.5 L'Hôpital's Rule
- 4.6 Analyzing and Sketching Graphs of Functions
- 4.7 Applied Optimization
- 4.8 Newton's Method