

Fariborz Maseeh Department of Mathematics and Statistics

Mth 251: Calculus I

Updated Fall 2018

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

Suggested Textbook:

Jon Rogawski and Colin Adams, *Calculus: Early Transcendentals*, 3rd ed., Freeman, W.H. & Company 2015.

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Current MTH 251 Textbook Mapping:

Jon Rogawski and Colin Adams, *Calculus: Early Transcendentals*, 3rd ed., Freeman, W.H. & Company 2015.

1 Precalculus Review

1.1 Real Numbers, Functions, and Graphs

2 Limits

- 2.1 Limits, Rates of Change, and Tangent Lines
- 2.2 Limits: A Numerical and Graphical Approach
- 2.3 Basic Limit Laws
- 2.4 Limits and Continuity
- 2.5 Evaluating Limits Algebraically
- 2.6 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 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 Shape of a Graph
- 4.5 L'Hopital's Rule
- 4.6 Graph Sketching and Asymptotes
- 4.7 Applied Optimization
- 4.8 Newton's Method