

## MA113 Calculus I

### Course Objectives

1. Approximate limits graphically and numerically and evaluate limits analytically.
2. Evaluate infinite limits, limits at infinity, and limits of indeterminate form including the use of L'Hospital's Rule.
3. List the conditions for the continuity of a function at a point and determine the intervals of continuity of a function.
4. Define the derivative of a function and evaluate the derivative using the definition.
5. Determine the derivative of a function using differentiation rules for algebraic, trigonometric and transcendental functions.
6. Use product rule, quotient rule and chain rule techniques to determine derivatives of functions.
7. Write the equation of a line tangent to a curve at a given point using derivatives.
8. Use calculus to sketch graphs of functions.
9. Determine derivatives using implicit differentiation.
10. Define the integral of a function and evaluate using the definition of integration.
11. Find indefinite and definite integrals of a function using integration rules for algebraic, trigonometric and transcendental functions.
12. Use substitution techniques to determine the definite and indefinite integrals of functions.
13. Analyze information to develop models for solving applications problems involving related rates, optimization, area under curves and velocity/acceleration.

### MA113 Course Competencies

- A. Knowledge of human cultures and the physical and natural worlds through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts.
- B. Intellectual and practical skills, including
  - inquiry and analysis
  - critical and creative thinking
  - written and oral communication
  - quantitative literacy
  - information literacy
  - teamwork and problem solving
- C. Personal and social responsibility, including
  - civic knowledge and engagement (local and global)
  - intercultural knowledge and competence
  - ethical reasoning and action
  - foundations and skills for lifelong learning
- D. Integrative and applied learning, including synthesis and advanced accomplishment across general and specialized skills.

## Student Learning Outcomes for Quantitative Reasoning

In MA 113, students will learn to:

1. Interpret information presented in mathematical and/or statistical forms by (Gen Ed Comp B):
  - Approximating limits graphically and numerically and evaluating limits analytically.
  - Defining the derivative of a function and evaluating the derivative using the definition.
  - Defining the integral of a function and evaluating using the definition of integration.
2. Illustrate and communicate mathematical and/or statistical information symbolically, visually, and/or numerically by (Gen Ed Comp A, B, C):
  - Listing the conditions for the continuity of a function at a point and determining the intervals of continuity of a function.
  - Using calculus to sketch graphs of functions.
3. Determine when computations are needed and execute the appropriate computations by (Gen Ed Comp A, B):
  - Evaluating infinite limits, limits at infinity, and limits of indeterminate form including the use of L'Hospital's Rule.
  - Determining the derivative of a function using differentiation rules for algebraic, trigonometric and transcendental functions.
  - Using product rule, quotient rule and chain rule techniques to determine derivatives of functions.
  - Determining derivatives using implicit differentiation.
  - Finding indefinite and definite integrals of a function using integration rules for algebraic, trigonometric and transcendental functions.
  - Using substitution techniques to determine the definite and indefinite integrals of functions.
4. Apply an appropriate model to the problem to be solved by (Gen Ed Comp A, B, C):
  - Writing the equation of a line tangent to a curve at a given point using derivatives.
5. Make inferences, evaluate assumptions, and assess limitations in estimation modeling and/or statistical analysis by (Gen Ed Comp A, D):
  - Analyzing information to develop models for solving applications problems involving related rates, optimization, area under curves and velocity/acceleration.

## MA 113 Course Outline

- I. Functions
  - A. Review
    - 1. Composition
    - 2. Inverses
    - 3. Trigonometric Functions
  - B. Exponential Functions
    - 1. Definition
      - a. Natural Exponential
      - b. General Exponential
    - 2. Properties
    - 3. Graphs
    - 4. Exponential Growth & Decay
  - C. Logarithmic Functions
    - 1. Definition
      - a. Natural Logarithm
      - b. General Logarithm
    - 2. Properties
    - 3. Graphs
  - D. Inverse Trig Functions
    - 1. Definitions
    - 2. Properties
    - 3. Graphs
- II. Limits of a Function
  - A. Definition
  - B. Left and Right Handed Limits
  - C. Graphical Limits
  - D. Algebraic Limits
  - E. Trigonometric Limits
  - F. Infinite Limits
  - G. Limits at Infinity
  - H. Indeterminate Forms
    - $\frac{0}{0}, \frac{\infty}{\infty}, \infty - \infty, 0 \cdot \infty, 0^0, \infty^0, 1^\infty$
  - I. L'Hospital's Rule
  - J. Squeeze Theorem
  - K. Continuity
    - 1. Definition
    - 2. Intermediate Value Theorem

## III. Derivatives

- A. Definition
- B. Differentiation Formulas
  - 1. Power Rule
  - 2. Product Rule
  - 3. Quotient Rule
  - 4. Chain Rule
- C. Higher Order Derivatives
- D. Implicit Differentiation
- E. Logarithmic Differentiation

## IV. Applications of Derivatives

- A. Tangent Lines
- B. Rolle's Theorem
- C. Mean Value Theorem
- D. Rates of Change
- E. Related Rates
- F. Linear Approximations and Differentials
- G. Optimization

## V. Graphing with Calculus

- A. Increasing and Decreasing Functions
- B. Relative Extrema
- C. Concavity
- D. Inflection Points
- E. Asymptotes
  - 1. Vertical
  - 2. Horizontal
  - 3. Oblique
- F. Curve Sketching

## VI. Integration

- A. Riemann Sums
- B. Antiderivatives
- C. Fundamental Theorem of Calculus
- D. Definite Integrals
- E. Indefinite Integrals
- F. Substitution Integrals

## VII. Applications of Integrals

- A. Area Under a Curve
- B. Net Change
- C. Velocity & Acceleration

