MTH/MATH 251Z Differential Calculus

For more detailed information, see CCN Reports & Memos on the Resources for CCN webpage.

CCN Course/Course Information
Math
Course Number and Prefix: MTH or MATH 251Z **Course Title:** Differential Calculus **Course Credits:** 4 **Course Description:** This course explores limits, continuity, derivatives, and their applications for real-valued functions of a single variable. These topics will be explored graphically, numerically, and symbolically in real-life applications. This course emphasizes abstraction, problem-solving, modeling, reasoning, communication, connections with other disciplines, and the appropriate use of technology. **Course Learning Outcomes:** At the end of the course, students will be able to… 1. Calculate limits graphically, numerically, and symbolically; describe the behavior of functions using limits and continuity; and recognize indeterminate forms. 2. Apply the definition of the derivative and analyze average and instantaneous rates of change. 3. Interpret and apply the concepts of the first and second derivative to describe and illustrate function features including the slopes of tangent lines, locations of extrema and inflection points, and intervals of increase, decrease, and concavity. 4. Apply product, quotient, chain, and function-specific rules to differentiate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions, as well as functions defined implicitly. 5. Apply derivatives to a variety of problems in mathematics and other disciplines, including related rates, optimization, and L'Hôpital's rule. **Required Course Content**: At the end of the course, students will be able to… 1. Calculate limits graphically, numerically, and symbolically; describe the behavior of functions using limits and continuity; and recognize indeterminate forms. a. Students will be able to calculate limits graphically, numerically, and algebraically. b. Students will be able describe the local and global behavior of functions using limits. c. Students will be able to describe the notion of continuity using limits and determine whether a function is continuous. d. Students will be able to recognize and evaluate indeterminate forms. 2. Apply the definition of the derivative and analyze average and instantaneous rates of change. a. Students will be able to state and use the definition of the derivative to calculate the derivatives of simple functions. b. Students will be able to determine whether a function is differentiable using limits.

c. Students will be able to describe the connection between the definition of the derivative and the average and instantaneous rates of change of a function.

d. Students will be able to use derivatives in applications using appropriate units.

3. Interpret and apply the concepts of the first and second derivative to describe and illustrate function features including the slopes of tangent lines, locations of extrema and inflection points, and intervals of increase, decrease, and concavity.

   a. Students will recognize and apply the concept of the derivative to describe and find the slopes of tangent lines.

   b. Students will be able to use the derivative to identify the intervals on which a function is increasing or decreasing, and the locations of extreme values.

   c. Students will be able to use the second derivative to identify intervals of concavity and the locations of inflection points.

4. Apply product, quotient, chain, and function-specific rules to differentiate combinations of power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions, as well as functions defined implicitly.

   a. Students will be able to differentiate power, polynomial, rational, exponential, logarithmic, trigonometric, and inverse trigonometric functions algebraically.

   b. Students will be able to apply sum, constant multiple, product, quotient, and chain rules to differentiate combinations of functions listed above.

   c. Students will be able to differentiate functions defined implicitly.

5. Apply derivatives to a variety of problems in mathematics and other disciplines, including related rates, optimization, and L'Hôpital's rule.

   a. Students will be able to recognize when L'Hôpital's rule is appropriate and use it to calculate limits involving indeterminate forms.

   b. Students will be able to use the derivative to solve related rates problems.

   c. Students will be able to use the derivative to solve optimization problems.

   d. Students will be able to interpret and communicate the meaning of the derivative and its application in context, including using appropriate notation.