MTH/MATH 251Z Differential Calculus

The following provides a summary of the 2023 Recommendation Report for the CCN Math Subcommittee. Transfer Council recommends that due to changes in course information under OAR 715-025-0065 through 0115, colleges and universities should ensure students' academic progress is not disrupted. Courses completed before CCN changes should count toward graduation, even if requirements shift. Holding students harmless means honoring their efforts, supporting them through transitions, and keeping learning—not compliance—the central focus. CCN course information should be adopted as written. For more detailed information on what can be added to the course description and course learning outcomes, see the CCN Revised Framework and for more general information, see CCN Reports & Memos on the Educator Resources—Common Course Numbering webpage.

Approved CCN Course Information

Date Approved:
October 17, 2024

Catalog Dates:
Required to begin appearing in the 2025-26 catalog.

Review Timeline:

- First Annual Review: Winter 2026
- First Triennial Review: Winter 2027

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.

Review Cycle:

Our annual meetings, likely 6 hours each (split over 2-3 weeks) would be dedicated to discussing faculty and student experience of commonly numbered courses, looking at data collected either by our local institutions or the HECC, and identify areas of improvement and suggested changes to the courses aligned above.

Our triennial workshops, likely 12 hours (perhaps split into 6 weeks, or 2 long days) would be dedicated to more definitive problem-solving and recommendation-making based on the data and experiences referenced above. We believe that a three-year review cycle will be sufficient to keep these courses up-to-date and ensure continued transferability around the state.
