Math 251: Differential Calculus **(4-0-4)** 4/20/15

Catalog Description: Theory, computational techniques and applications of the derivative.

Course Objectives: After completing this course, students will be able to

1. Understand limits and continuity from the graph of a function.
2. Understand limits from the formula of a function without a graph.
3. Understand the concept and mathematical definition of a derivative.
4. Use the rules of differentiation to find derivatives explicitly and implicitly.
5. Use derivatives to solve applied problems.
6. Communicate mathematical ideas using correct and appropriate notation.

Learning Outcomes and Performance Criteria

1. Understand limits and continuity from the graph of a function.
   Core Criteria:
   (a) Use the graph of a function to determine left and right hand limits at a point.
   (b) Use left and right hand limits obtained from the graph of a function to determine a limit at a point.
   (c) Use limit notation correctly.
   (d) Determine and classify points of discontinuity from the graph of a function.
2. Understand limits from the formula of a function without a graph.
   Core Criteria:
   (a) Calculate left and right hand limits.
   (b) Calculate limits at a point.
   (c) Calculate limits at infinity.
   (d) Calculate limits with L'Hospital's rule.

   Additional Criteria:
   (e) Calculate points of discontinuity.
   (f) Calculate vertical and horizontal asymptotes.
3. Understand the concept and mathematical definition of a derivative.
   Core Criteria:
   (a) Use the definition of the derivative to calculate the derivative of a polynomial.
   (b) Use derivative notation correctly.
   (c) Determine average rates of change of a function algebraically from its expression.
   (d) Determine average rates of change of a function from its graph.

   Additional Criteria:
   (e) Use the derivative to calculate the derivative of a discrete function. Here the function and its derivative are specified only as a set of points.
   (f) Calculate average velocity from a set of data points over an interval.
   (g) Calculate an estimate for the instantaneous velocity at a point from a set of data points.

(h) Approximate the instantaneous rate of change (or slope of the graph, or derivative) of a function at a point, from its graph.

4. Use the rules of differentiation to find derivatives explicitly and implicitly.

   Core Criteria:

   (a) Calculate explicit derivatives of functions of polynomials, trigonometric functions, exponential, and logarithmic functions with the power, quotient, product, and chain rule.

   (b) Use implicit differentiation to calculate implicit derivatives of inverse trigonometric functions and implicit equations.

   (c) Calculate higher order derivatives.

   (d) Use the graph of a function to draw the graph of its derivative.

   Additional Criteria:

   (e) Use the graph of the derivative of a function to graph the original function.

5. Use derivatives to solve applied problems.

   Core Criteria:

   (a) Set up and solve word-problems with related rates.

   (b) Set up and solve word-problems on optimization.

   (c) Calculate the local maxima and minima and also the absolute max and min of a function on an interval.

   (d) Use the derivative of a function to determine where it is increasing and where it is decreasing.

   (e) Distinguish between the extrema of a function and the locations of those extrema.

   (f) Given a position function, determine the velocity and acceleration for a particle in rectilinear motion.

   Additional Criteria:

   (g) Use the second derivative of a function to determine where it is concave up, and where it is concave down.

   (h) Determine where a particle is moving right, moving left or stopped, and where it is speeding up and where it is slowing down.