

## Content Outline and Course Competencies for Calculus I:

The course outcomes for Calculus I included in this document apply to any Kansas public college or university teaching a calculus I course that is the equivalent of the first semester in a three-semester calculus sequence.

- I. Using Limits.
  - a. Evaluation of Limits
    - Evaluate the limit of a function at a point both algebraically and graphically
    - Evaluate the limit of a function at infinity both algebraically and graphically
    - Use the definition of a limit to verify a value for the limit of a function
  - b. Use of Limits
    - Use the limit to determine the continuity of a function
    - Apply the Intermediate-Value Theorem
    - Use the limit to determine differentiability of a function
  - c. Limiting Process
    - Use the limiting process to find the derivative of a function.
- II. Finding Derivatives
  - Find derivatives involving powers, exponents, and sums
  - Find derivatives involving products and quotients
  - Find derivatives involving the chain rule
  - Find derivatives involving exponential, logarithmic, and trigonometric functions
  - Find derivatives involving implicit differentiation
- III. Using Derivatives
  - a. Curve Sketching
    - Use the first derivative to find critical points
    - Apply the Mean-Value Theorem for derivatives
    - Determine the behavior of a function using the first derivative
    - Use the second derivative to find inflection points
    - Determine the concavity of a function using the second derivative
    - Sketch the graph of the function using information gathered from the first and second derivatives
    - Interpret graphs of functions
  - b. Applications of Derivatives
    - Use the derivative to find velocity, acceleration, and other rates of change
    - Use the derivative to find the equation of a line tangent to a curve at a given point

- Use optimization techniques in areas such as economics, the life sciences, the physical sciences, and geometry
- Solve related rates problems
- Use Newton's Method
- Use differentials to estimate change

#### IV. Finding Integrals

- Find area using Riemann sums and integrals
- Express the limit of a Riemann sum as a definite integral
- Evaluate the definite integral using geometry
- Integrate algebraic, exponential, and trigonometric functions
- Evaluate definite integrals using the Fundamental Theorem of Calculus
- Apply the Mean-Value Theorem for integrals
- Integrate indefinite integrals
- Integrate using substitution
- Approximate integrals using Simpson's Rule and the Trapezoidal Rule.

#### **Comments:**

Kansas Public College and University mathematics professors believe that a strong foundation in the concepts of calculus will lead to success in careers that have a strong emphasis in critical thinking, such as engineering, computer science, or biotechnology. However, this will not happen if calculus is taught at primarily a skills and formula level without sufficient time to engage students in the deeper, conceptual tenets of calculus. All calculus teachers have an obligation to the mathematics community to ensure that students completing a first-semester, mainstream calculus course understand the material in a rigorous fashion at the level required to pass the AP Calculus exam.