Calculus
Course Outline and Objectives

Unit One: Prerequisites

A brief Review of:

A. The set of Real Numbers, inequalities, absolute value and its properties.
B. The distance and midpoint formulas,
C. Graphing circles.
D. Graphing equations with and without a graphics calculator, locating x and y-intercepts, identifying the symmetries associated with a given equation, locating the points of intersection of two equation by algebra and with the use of the graphics calculator.
E. Finding the equation of a line given:
    1. A point and a slope.
    2. Two points.
    3. That is parallel or perpendicular to a given line that passes through a given point.
F. Functions
    1. Find the domain and range of a given function.
    2. Evaluate and create composite functions.
    3. Determine whether a given function is odd, even, or neither.
G. Trig functions
    1. Graphing trig functions using a graphics calculator.
    2. Work with conversions from degrees to radians and radians to degrees and with problems that involve arc length.
    3. Solve trig equations and work with trig identities.
    4. Evaluate trig functions.

Unit Two: A Detailed Study of Limits & Their Properties

A. Formal definition of limit
    1. Exploring limits that exist vs. limits that do not exist
B. A detailed study of the limit properties
    1. Scalar multiplication property
    2. Sum and difference properties
    3. Product and quotient properties
    4. Power property
C. Exploring techniques for evaluating limits
    1. Making tables of values using the graphics calculator
    2. Simplifying using algebra and rationalization skills
D. Exploring one-sided limits
    1. A study of the greatest integer function, the absolute value function, and rational functions.
E. Infinite limits
    1. A study of continuity on an open interval
    2. A study of removable and non-removable points of discontinuity.
    3. A study of vertical asymptotes.
F. Demonstrate the use of the Intermediate Value Theorem.

Unit Three: A Detailed Study of Differentiation

A. Using the limit definition to find the slope of a tangent line to a curve at a specific point on the curve, and then use this slope to find the equation of the tangent line.
B. Determine whether a function is differentiable at a given point by checking for:
    1. Continuity at the given point.
    2. A vertical tangent line at the given point
    3. A sharp cusp in the graph.
C. Learn to use the following rules to differentiate given functions.
    1. The derivative of a constant is zero.
    2. The Power Rule
    3. The sum and difference rules.
    4. The product rule.

5. The quotient rule.
6. The Chain Rule.

D. Learn how to differentiate expressions that contain trig functions.
E. Use implicit differentiation to calculate derivatives.
   1. Apply knowledge of implicit differentiation to solving rate of change problems.
F. Apply differentiation rules to taking higher order derivatives.
G. Solving problems using know of derivatives.
   1. Velocity and acceleration problems.
   2. Rate of change problems.
   3. Projectile motion problems

Unit Four: Applications of Derivatives

A. Finding the extrema of a function
   1. Locate all critical values on a closed interval.
      a. Interval endpoints
      b. Where f (x) = 0 or where f (x) is undefined.
   2. Evaluate the critical values to identity the extrema (maximum and minimum) on a open or closed interval.
B. Explore the use of Rolles Theorem and the Mean Value Theorem.
C. Explore the use of the first derivative test.
   1. To identify pause points and use a line test to determine if the point is a local maximum or minimum points.
   2. To determine whether a function is increasing or decreasing in a given interval.
D. Explore the concavity using the second derivative test.
E. Using knowledge gained from the first and second derivative tests to sketch accurate graphs of functions.
F. Continued study of limits that approach infinity to identify vertical and horizontal asymptotes to aid in graphing functions.
G. Introduction to the study of differential equations.
H. A detailed study of optimization problems.
I. An introduction to the study of business and economic applications that involve the use of derivatives.

Unit Five: Detailed Study of Integration

A. Introduction to various notations used to denote antiderivatives, the rules that apply to taking antiderivatives, introduction to indefinite integrals, and to finding a particular solution to an indefinite integral.
B. Introduction to sigma notation and its use to find areas under curves using the limit definition.
C. Introduction to the use of Riemann Sums and their use to evaluating definite integrals.
D. Introduction to the Fundamental Theorem of Calculus and its use to evaluate definite integrals.
E. Evaluating definite integrals using substitution techniques.

Unit Six: A Detailed Study of Logarithmic & Exponential Differentiation and Integration

A. Review of log properties and their use to solve equations.
B. Applying rules for taking derivatives to functions that include e^x, ln(x), log(x) and a^x.
C. Continued study of implicit differentiation.
D. Introduction to logarithmic differentiation.
E. Applying the rules for integrating define and indefinite integrals to integrating expressions that include e^x, a^x, and (1/x).
F. Solving word problems that deal with exponential growth and decay.

Unit Seven: Calculating the Area Between Curves & Finding Volumes of Revolution

A. Calculating the area between a curve and either the x-axis or the y-axis using given parameters for the variables. Calculating the area between two curves.
B. Calculating the volume of a region that is revolved about the x-axis, the y-axis, or a horizontal or vertical line using disks, washers, and shells.