Calculus G/T
Essential Curriculum

UNIT I: Functions and Change

Goal. The student will demonstrate the ability to use a problem solving approach to analyze functions. They will use recursive expressions, conduct investigations using technology, identify and discuss the relative behavior of functions, and develop mathematical models.

Objectives – The student will be able to:

a. Model real world applications using functions and technology.
b. Identify input/output variables. (dependent/independent variables)
c. Identify and describe relative behavior of linear, polynomial, exponential, logarithmic, and logistic functions.
d. Identify and describe relative behavior of continuous versus discrete change models.
e. Apply modeling to business applications which may include present and future values, as well as exponential growth and decay.
f. Identify and describe relative behavior of trigonometric functions.

UNIT II: Limits of Functions

Goal. The student will demonstrate the ability to use a problem solving approach to a estimate and determine the limit of a function.

Objectives – The student will be able to:

a. Estimate limits of functions from graphs and tables of values.
b. Explain concept of limits verbally and graphically in terms of continuous and discrete models, as well as in terms of secant and tangent lines.
c. Determine limits using algebraic rules, such as replacement and cancellation rules.
d. Determine limiting behavior at infinity.

UNIT III: Rates of Change (The Derivative Concept)

Goal. The student will demonstrate the ability to use a problem-solving approach, with technology, to study the mathematics of change. The student will use analytical, graphical, verbal, and numerical methods to study the derivative of a function as a rate of change.

Objectives – The student will be able to:

a. Discuss the concept of average rates of change verbally and graphically.
b. Discuss the concept of percentage change and percentage rate of change.
c. Demonstrate average rates of change using the slope of secant lines.
d. Use technology to demonstrate that the tangent line is the limit of the secant line as $x \to 0$.
e. Use technology to demonstrate local linearity of a function and how this relates to the tangent line.

f. Explain instantaneous rates of change at a point in terms of the tangent line and local linearity.
g. Estimate the instantaneous rate of change using the slope of the tangent line.
h. Define the derivative of a function as the limit of the difference quotient.
i. Explain the relationship between differentiability and continuity of functions and of points in terms of continuous and discrete models.
j. Estimate the graph of the instantaneous rate of change function (derivative) using the slope of the tangent line and derivative methods.

UNIT IV: Techniques of Differentiation

Goal. The student will demonstrate the ability to use a problem solving approach to apply rules of differentiation to a variety of functions.

Objectives – The student will be able to:
a. Interpret the terminology and notations used to describe a derivative.
b. Find the derivative of a function using the Power Rule, Sum/Difference Rule, Product Rule (Quotient Rule not found in the text is optional), and the Chain Rule.
c. Find the derivative of exponential and logarithmic functions.
d. Find the derivative of basic trigonometric functions.
e. Perform implicit differentiation.

UNIT V: A Function's Relationship to its Derivative

Goal. The student will demonstrate the ability to use a problem solving approach to identify and analyze the relationship between a function and its derivative.

Objectives – The student will be able to:
a. Identify points (and discuss their importance) that have horizontal and vertical tangents – critical points.
b. Identify points (and discuss their importance) where concavity changes – inflection points.
c. Identify intervals where a function is increasing or decreasing and discuss the associated real-world implications.

UNIT VI: Applications of the Derivative

Goal. The student will demonstrate the ability to use a problem solving approach to apply derivatives model, analyze, and solve real-world problems.

Objectives – The student will be able to:
a. Solve optimization problems.
b. Solve basic rate problems.
c. Solve related rate problems.
d. Solve additional problems in Science and Economics. Examples may include Marginal Analysis, Elasticity of Demand, Average Cost, and Drug Concentration.

UNIT VII: Accumulation of Change (The Integral Concept)

Goal. The student will demonstrate the ability to use a problem solving approach to estimate and calculate the definite integral of a function, and to find the antiderivative of elementary functions.

Objectives – The student will be able to:

a. Recognize in linear models that the area under the curve represents distance traveled and calculate the distance using geometry.
b. Estimate area under a curve of non-linear functions using rectangles, trapezoids and technology.
c. Define the limit of the sums of the area as the definite integral.
d. Use the Fundamental Theorem of Calculus to find antiderivatives of elementary functions.
e. Define the indefinite integral and antiderivative function.

UNIT VIII: Applications of Integration

Goal. The student will demonstrate the ability to use a problem solving approach to apply integration to model, analyze, and solve real-world problems.

Objectives – The student will be able to:

a. Find the area between two curves.
b. Solve problems in Science and Economics. Examples may include Present and Future Value, Supply and Demand, Population Growth, and Average Value.
c. Solve problems involving probability and statistics.