Mathematical Analysis - Honors
Essential Curriculum

Unit 1: Sequences and Series

Goal: The student will demonstrate the ability to identify and evaluate arithmetic and geometric sequences and series.

Objectives - The student will be able to:

a. Use sequence notation to write the terms of a sequence.
b. Write an arithmetic sequence recursively and explicitly.
c. Use factorial and summation notation.
d. Find the nth term and the partial sum of an arithmetic sequence.
e. Recognize and write a geometric sequence recursively and explicitly.
f. Find partial sums of a geometric sequence.
g. Find the sum of an infinite geometric series.
h. Use arithmetic and geometric sequences and series to model and solve realworld problems.

Unit 2: Graphical Analysis of Functions

Goal: The student will demonstrate the ability to describe, analyze, and interpret graphs of functions to solve real-world problems.

Objectives - The student will be able to:

a. Analyze graphs to determine domain and range, zeros, local maxima and minima, and intervals where the graphs are increasing and decreasing and concavity.
b. Use graphs of functions to model and solve real-world problems.
c. Recognize graphs and transformations of common functions.
d. Sketch the graph of a transformation.
e. Use knowledge of graphical symmetry to determine if a function is even, odd or neither and sketch the graph.
f. Identify and graph absolute value, greatest integer, step, and other piecewise-defined functions.

Unit 3: Algebraic Analysis of Functions and Vectors

Goal: The student will demonstrate the ability to perform operations on functions and algebraic vectors.

Objectives – The student will be able to:

a. Perform addition, subtraction, multiplication, division, and composition of functions.

b. Define inverse relations and functions and determine whether an inverse relation is a function.
c. Verify inverses using composition.
d. Define algebraic vectors.
e. Define and compute the magnitude and direction of algebraic vectors.
f. Define a unit vector.
g. Find the sum and difference of algebraic vectors.
h. Perform scalar multiplication.
i. Define and compute the dot product of two vectors.
j. Find the angle between two vectors.
k. Determine if two vectors are parallel or perpendicular.

Unit 4: Polynomial Functions

Goal: The student will demonstrate the ability to use a problem-solving approach to investigate polynomial functions and equations, both with and without the use of technology.

Objectives – The student will be able to:

a. Determine domain and range, zeros, local maxima and minima, and intervals where the graphs are increasing and decreasing and concavity.
b. Use common characteristics of a polynomial function to sketch its graph.
c. Analyze a function numerically and graphically to determine if the function is odd, even, or neither.
d. Use the Fundamental Theorem of Algebra to determine the number of zeros of a polynomial.
e. Find all rational, irrational, and complex zeros of a polynomial using algebraic methods.
f. Use polynomial functions to model and solve real-world problems.

Unit 5: Exponential, Logarithmic, and Logistic Functions

Goal: The student will demonstrate the ability to investigate exponential, logarithmic, and logistic functions and solve real-world problems, both with and without the use of technology.

Objectives – The student will be able to:

a. Sketch and analyze exponential functions and their transformations.
b. Define the natural base.
c. Express the inverse of an exponential function as a logarithmic function.
d. Evaluate logarithms to any base with and without a calculator.
e. Use and apply the laws of logarithms and the change of base formula.
f. Sketch and analyze logarithmic functions and their transformations.
g. Solve exponential and logarithmic equations.
h. Sketch and analyze logistic functions.
i. Compare and contrast the exponential and logistic models.

j. Solve real-world problems including exponential growth and decay, compound interest, and applications of logarithms and logistic functions.

Unit 6: Rational Functions

Goal: The student will demonstrate the ability to use a problem-solving approach to investigate rational functions and solve real-world problems, both with and without the use of technology.

Objectives – The student will be able to:

a. Determine the domain, range, and end behavior of rational functions.
b. Algebraically identify intercepts, holes, and vertical, horizontal, and slant asymptotes in order to sketch graphs of rational functions.
c. Use graphical and algebraic methods to solve rational equations and inequalities.
d. Use rational functions to model and solve real-world problems.
e. Decompose a fraction with a factorable quadratic denominator and a linear or constant numerator.

Unit 7: Radicals, Special Functions, and Parametrics

Goal: The student will demonstrate the ability to use a problem-solving approach to investigate parametrics, radical and special functions, both with and without the use of technology.

Objectives – The student will be able to:

a. Determine the domain, range, and end behavior of radical functions.
b. Use graphical and algebraic methods to solve radical equations and inequalities.
c. Use radical functions to model and solve real-world problems.
d. Sketch and analyze absolute value, greatest integer, and piecewise functions.
e. Solve inequalities involving absolute value functions.
f. Find a parametrization of a given equation.
g. Graph parametric equations and compare to the equivalent Cartesian equation.
h. Apply parametric equations to the solution of motion problems.

Unit 8: Limits

Goal: The student will demonstrate the ability to calculate limits and apply limits to continuity of functions and tangent line problems.

Objectives – The student will be able to:

a. Use the informal definition of limit.
b. Calculate limits algebraically and estimate limits from graphs and tables of values.
c. Use and apply the properties of limits to find the limit of various functions.
d. Use one-sided limits to describe continuity of functions.
e. Determine if a function is continuous at a point or over an interval.

f. Determine the limit of a function as the domain approaches infinity.
g. Apply limits using the definition of derivative with respect to tangent lines of functions.