

NORTH ALLEGHENY SCHOOL DISTRICT

MATHEMATICS DEPARTMENT

HONORS PRE-CALCULUS SYLLABUS

COURSE NUMBER: 3421

Units of Credit: 1.0 credits, honors weight

Course Length: 184 days (full year)

## **Course Overview**

This is a rigorous course for the accelerated student. It requires a strong foundation in algebra and geometry. Major emphasis is placed on algebraic concepts and analysis of curves, functions, and graphing techniques. This course also contains a study of trigonometry from the circular and right triangle perspective. The analysis of conic sections and other geometric curves from a coordinate point of view is also studied. Students will be introduced to the key calculus topics including limits. To be successful, students must possess the motivation and a willingness to work hard. Students need to be highly motivated to learn. Students also need to display a positive attitude while maintaining a continual desire to learn the mathematical concepts and not just work problems. They need to have the ability to read and learn mathematics independently.

## **Mathematics Department Curriculum Differentiation**

The Advanced/Honors Mathematics courses are intended to be more challenging than Academic courses and are designed to provide multiple opportunities for students to take an increased responsibility for their own learning and achievement. These courses are designed for students who have demonstrated an advanced level of achievement in mathematics. The curriculum is distinguished by a difference in rigor, relevance, and the quality of the work, not merely the quantity. The content of these courses is rigorous in its breadth and depth of study.

The key distinctions between Academic and Advanced/Honors curriculum at each level are:

- **Expectation of Performance**: Students in Advanced/Honors Mathematics courses will have different performance expectations.
- **Assignments**: The complex nature of Advanced/Honors Mathematics courses will have assignments that reflect the rigor of these courses.
- **Pacing Guides**: The pacing of instruction of the Advanced/Honors Mathematics courses will be accelerated to challenge the students enrolled in these courses.
- **Assessments**: The assessments of the Advanced/Honors Mathematics course will include cognitive and performance based tasks that will measure the students' synthesis, application and analysis of the material.

## **Textbook**

Larson, Hostetler, Pre Calculus with Limits, Boston: Houghton Mifflin Company, 2007

## Course Outline

The following topics are covered in Honors Pre Calculus:

### Chapter 1: Functions and Their Graphs

- Sketch graphs of equations
- Find x – and y – intercepts of equations
- Use symmetry to sketch graphs of equations
- Use graphs of equations to solve real-life problems
- Find and use slope to graph equations in two variables
- Use slope to identify parallel and perpendicular lines
- Determine whether the relation between two variables is a function
- Evaluate functions
- Find domains of functions
- Use the vertical line test for functions
- Determine when functions are increasing or decreasing and when they are even or odd
- Identify and graph of linear, squaring, cubic, square root, reciprocal, step and piece-wise functions
- Transform functions by shifting, reflecting, stretching and shrinking
- Add, subtract, multiply and divide functions
- Find the composition of one function with another
- Find inverse functions

### Chapter 2: Polynomial and Rational Functions

- Analyze graphs of quadratic functions
- Write quadratic functions in standard form and use the results to sketch graphs of functions and to solve real-life problems
- Use transformations to sketch graphs of polynomial functions
- Find and use zeros of polynomial functions
- Use long division and synthetic division to divide polynomials by other polynomials
- Use the Remainder Theorem and the Factor Theorem
- Use the imaginary unit  $i$  to write complex numbers
- Perform operations and solve equations with complex numbers
- Find rational, real and complex solutions of polynomial functions
- Sketch graphs of polynomial and rational functions by finding intercepts, asymptotes and holes
- Solve polynomial and rational inequalities

### Chapter 3: Exponential and Logarithmic Functions

- Recognize, evaluate and graph exponential functions with base  $a$  and base  $e$
- Recognize, evaluate and graph common and natural logarithms
- Use exponential and logarithmic functions to model real-life problems
- Use properties of logarithms to evaluate, rewrite or expand logarithmic expressions
- Solve simple and complicated exponential and logarithmic equations

### Common Math Assessment

### Chapter 4: Trigonometry

- Describe angles
- Use degree and radian measure
- Identify a unit circle and describe its relationship to real numbers
- Evaluate trigonometric functions using the unit circle
- Use domain and period to evaluate sine and cosine functions
- Use a calculator to evaluate trigonometric functions
- Use trigonometric functions to model and solve real-life problems
- Evaluate trigonometric functions of any angle
- Sketch the graphs of sine, cosine, tangent, cotangent, secant and cosecant curves
- Evaluate and graph inverse trigonometric functions
- Evaluate composition of trigonometric functions
- Solve real-life problems involving right triangles, directional bearing and harmonic motion

### Chapter 5: Analytic Trigonometry

- Recognize and write fundamental trigonometric identities
- Use the fundamental trigonometric identities to evaluate trigonometric functions, simplify trigonometric expressions, and rewrite trigonometric expressions
- Verify trigonometric identities
- Use standard algebraic techniques to solve trigonometric equations
- Solve trigonometric equations of quadratic type, involving multiple angles, or using inverse trigonometric functions
- Use sum and difference formulas to evaluate trigonometric functions, verify identities, and solve trigonometric equations
- Use multiple-angle, power-reducing, half-angle, product-to-sum and sum-to-product formulas to rewrite and evaluate trigonometric functions
- Use trigonometric formulas to rewrite real-life problems

### Chapter 6: Additional Topics of Trigonometry

- Use the Law of Sines and Cosines to solve oblique triangles
- Find the areas of oblique triangle
- Use the Law of Sines and Cosines to model and solve real-life problems
- Represent Vectors as directed line segments
- Write the component form of vectors
- Perform basic vector operations
- Find the dot product of two vectors and use properties of dot product
- Find the angle between two vectors and determine whether the two vectors are orthogonal
- Plot complex numbers in the complex plane and find absolute values of complex numbers
- Write trigonometric forms of complex numbers
- Multiply and divide complex numbers written in trigonometric form
- Use DeMoivre's Theorem to find powers of complex numbers
- Find  $n^{\text{th}}$  roots of complex numbers

### Chapter 7: Systems of Equations and Inequalities

- Use the method of substitution and elimination to solve systems of linear and nonlinear equations in two variables
- Use a graphical approach to solve systems of equations in two variables
- Use systems of equations to model and solve real-life problems
- Interpret graphically the numbers of solutions of systems of linear equations in two variables
- Find partial fraction decomposition of rational expressions
- Sketch the graphs and solve systems of inequalities in two variables
- Use systems of inequalities in two variables to model and solve real-life problems
- Solve linear programming problems
- Use linear programming problems to model and solve real-life problems

## Chapter 10: Topics in Analytic Geometry

- Find the inclination of a line
- Find the angle between two lines
- Find the distance between a point and a line
- Recognize a conic as the intersection of a plane and a double-napped cone
- Write the equations of parabolas, ellipses and hyperbolas in standard and general form
- To graph and find the key parts of parabolas, ellipses and hyperbolas
- Use the discriminant to classify conics
- Rotate conic sections
- Plot points on the polar coordinate system
- Convert points and equations from rectangular to polar form and vice versa
- Graph polar equations by plotting points
- Define conics in terms of eccentricity and write and graph equations of conics in polar form

## Common Math Assessment

### **Expected levels of student achievement**

The course is designed for students who want to be better prepared to take Advanced Placement courses while still in high school so that they may start in higher level courses upon entering college. Students will develop a deeper conceptual understanding of the mathematical skills in algebra and geometry. This bridges the gap between Algebra/Geometry and Calculus. Students will develop study habits that they can apply throughout their academic careers. Students will understand logical arguments behind the steps to solving problems.

### **Technology:**

A copy of the textbook on CD will be provided to all students. Ready access to the on-line video instruction and simulations is available through this CD. Students are expected to continue to grow in their use of technology. Students are expected to obtain a graphics calculator. We recommend purchasing from the Texas Instruments TI-84 family of calculators.

## **Standard Test Preparation**

The North Allegheny Mathematics Curriculum is designed to prepare students for standardized tests while meeting Pennsylvania State Mathematics Standards and Eligible Content. The focus will be on numbers and operations, algebraic concepts, geometry, data analysis and probability, and measurement. Students will be expected to complete Open Ended tasks throughout the course.