

## PRE-CALCULUS

**Code: M644 Full Year (12) (1 credit)**

Prerequisite: Algebra 2 & Trigonometry  
(rank weight 1.00)

Note: This course is intended for students who wish to further their understanding of mathematical structure and analysis.

Areas of Study Include:

- Trigonometry *(9 days)*
  - Define and evaluate the six trigonometric ratios.
  - Solve triangles using trigonometric ratios.
  - Define radian measure and convert angle measures between degrees and radians.
  - Define the trigonometric functions in terms of the unit circle.
  - Develop basic trigonometric identities.
  - Use trigonometric functions to model and solve real-world problems, including right triangle relations, arc length, and speed.
  
- Trigonometric Graphs *(7 days)*
  - Graph the sine, cosine, and tangent functions.
  - Identify the domain and range of a basic trigonometric function.
  - Graph transformations of the sine, cosine, and tangent graphs.
  - Graph the cosecant, secant, and cotangent functions and their transformations.
  - Identify and sketch the period, amplitude (if any), and phase shift of the cosine, sine, and tangent functions.
  - Use trigonometric graphs to model and solve real-world problems.
  
- Trigonometric Equations and Identities *(26 days)*
  - Solve trigonometric equations graphically and algebraically.
  - Define the domain and range of the inverse trigonometric functions.
  - Write a trigonometric function to model and solve real-world problems.
  - Apply strategies to prove identities.
  - Use the addition and subtraction identities for sine, cosine, and tangent functions.
  - Use the double-angle and half-angle identities.
  - Use identities to solve trigonometric equations.
  - Solve triangles using the Law of Cosines.
  - Solve triangles using the Law of Sines.
  - Applications of Laws of Cosines and Sines  
*(Not necessary to do Area.)*
  
- Applications of Trigonometry *(20 days)*
  - Vectors in the Plane

- 2 Dimensional Vectors
  - Vector Operations
  - Unit Vectors
  - Direction Angles
  - Applications of Vectors
- Dot Product of Vectors
  - Angle between Vectors
- Parametric Equations and Motion
  - Parametric Equations
  - Parametric Curves
  - Eliminating the Parameter
- Polar Coordinates
  - Coordinate Conversions
  - Coordinate Equations
- Graphs of Polar Equations
- DeMoivre's Theorem and  $n$ th Roots
  - The Complex Plane
  - Polar Form of Complex Numbers
  - Operations on Complex Polar Numbers
- Matrices (15 days)
  - Identifying Matrices
  - Matrix Addition and Scalar Multiplication
  - Matrix Multiplication
  - Identity and Inverse Matrices
  - Applying Matrices to Linear Systems
  - Applications:
    - Communication Matrices
    - Transition Matrices
    - Transformation Matrices

*Midyear*

- Analytic Geometry (10 days)
  - Eccentricity
  - Define a circle and write its equation.
  - Analyze and sketch the graph of a circle.
  - Define an ellipse and write its equation.
  - Analyze and sketch the graph of an ellipse.
  - Define a hyperbola and write its equation.
  - Analyze and sketch the graph of a hyperbola.
  - Define a parabola and write its equation.
  - Analyze and sketch the graph of a parabola.
  - Write the equation of and graph a translated conic section.
  - Use conic sections to model and solve real-world problems.

- Functions and Graphs (14 days)
  - Determine the domain and range of a function.
  - Evaluate piecewise-defined and greatest integer functions.
  - Analyze graphs to determine domain and range, local maxima and minima, intercepts, and intervals where they are increasing and decreasing.
  - Transform graphs of parent functions.
  - Determine whether a graph is symmetric with respect to the x-axis, y-axis, and/or origin.
  - Perform addition, subtraction, multiplication, division, and composition of functions.
  - Define inverse relations and functions and determine whether an inverse relation is a function.
  - Verify inverses using composition.
  
- Polynomial and Rational Functions (17 days)
  - Divide polynomials.
  - Apply the Remainder and Factor Theorems.
  - Determine the maximum number of zeros of a polynomial.
  - Find all rational zeros of a polynomial.
  - Simplify and perform operations on complex numbers.
  - Solve for the complex zeros of a polynomial.
  - Analyze and sketch polynomial functions using continuity, end behavior, intercepts, local extrema, and points of inflections.
  - Use polynomial functions to model and solve real-world problems.
  - Find the domain of a rational function.
  - Identify intercepts, holes, vertical, horizontal, and slant asymptotes in order to sketch graphs of rational functions.
  
- Exponential and Logarithmic Functions (21 days)
  - Simplify expressions containing radicals or rational exponents.
  - Graph and identify transformations of exponential functions, including the number.
  - Use exponential functions to model and solve real-world problems.
  - Graph and identify transformations of logarithmic functions.
  - Evaluate logarithms to any base with and without a calculator.
  - Apply properties and laws of logarithms to simplify and evaluate expressions.
  - Solve exponential and logarithmic equations.
  - Use exponential and logarithmic models to solve real-world problems.
  
- Limits (15 days)
  - Use the informal definition of limit.
  - Use and apply the properties of limits to find the limit of various functions.
  - Find one-sided limits.
  - Determine if a function is continuous at a point or an interval.
  - Find the limit as  $x$  approaches infinity

*8 days for review, 2 days for in-class final*

Optional Topics, if Time:

- An Introduction to Calculus
  - The Slope of a Curve
  - Using Derivatives in Curve Sketching
  - Extreme Value Problems
  - Velocity and Acceleration

Assessment: Pre-Calculus students will take a district-wide final exam in June.

Textbook: *Advanced Mathematics with Pre-Calculus*, published by McDougal Littell/Houghton-Mifflin, © 2003