# Math 2103:  Applied Pre-Calculus

**Credit hours:**      **4 credits (4 class hours per week)**
**Prerequisites:**      **Math 1200 or Math 1200C/0200C with a minimum grade of C or Math Placement Test**

## Course Description

Math 2103 is intended for students in the life and social sciences, and any other areas where the application of mathematics is important.  Students in this course will develop an understanding of functions and how they are used to model real world phenomena, including but not limited to change, motion and growth.  The linear, quadratic, power, polynomial, rational, exponential, logarithmic and periodic functions are studied in this course.  Students will become familiar with the algebraic, numerical and graphical properties of these functions.  This course is not intended for students planning to study mathematics, statistics, computer science, physical sciences, engineering or any other discipline requiring the complete calculus sequence.  Math 2103 is not an alternative to Math 2111 (Precalculus) and does not satisfy the prerequisite for Math 2141 (Calculus I).

## Course Objectives

1. Understand the algebraic, numerical and graphical properties of algebraic and early transcendental functions
2. Make calculations, apply concepts and methods, and develop mathematical models using the functions studied to analyze real world phenomena
3. Analyze the graphs of periodic functions and apply properties of sine or cosine

## Learning Outcomes

1. Determine the properties and behaviors of functions defined algebraically, numerically and graphically
2. Learn the relationship between a function, its graph, and its numerical and algebraic representation
3. Recognize the relationship between slope, linearity and constant rates of change
4. Identify the slopes and intercepts of linear functions, calculate slopes of lines and develop linear functions which can be used to model real world phenomena
5. Identify the algebraic and graphical properties of quadratic functions and solve quadratic equations
6. Use the properties of exponents to manipulate power functions into a particular form
7. Use power functions to model real world phenomena
8. Perform operations with functions, including addition, subtraction, multiplication, division and composition
9. Perform transformations on the graphs of functions, including horizontal translations, vertical translations, scaling, reflections and rotations about an axis
10. Determine if a function is one to one and find inverse functions
11. Recognize the properties and graphs of exponential functions
12. Use exponential functions to model growth and decay
13. Understand the concept of a logarithm and translate between exponential and logarithmic forms
14. Use logarithms of base 10, base e and other bases to solve exponential equations
15. Use logarithms to solve half-life and doubling time problems related to exponential growth and decay models
16. Understand the properties of basic polynomial functions and sketch their graphs
17. Find real zeros by factoring polynomial functions
18. Understand the properties of basic rational functions and sketch their graphs
19. Recognize right triangles and find the sine and cosine ratios of angles in standard position in the xy-plane
20. Be able to convert degree measure into radians
21. Graph functions involving sine or cosine
22. Find the period, amplitude, phase shift and vertical shift of such functions
23. Use a sine or cosine function to model periodic phenomenon

## Course Topics

I.   PROPERTIES OF FUNCTIONS
    A.  The algebraic and graphical definitions of a function
    B.  Graphs of equations in two variables
    C.  The vertical line test
    D.  The number line, inequalities and interval notation
    E.  Domain, range and interval notation
    F.  Using graphs of functions to model real world phenomena

II.  LINEAR FUNCTIONS
    A.  Linear equations in standard, point-slope and slope-intercept forms
    B.  Graphs of linear equations
    C.  The x-intercept and y-intercept of a line
    D.  The slope of a line
    E.  Use a linear function to model real world phenomenon
    F.  The slope of a line as a constant rate of change

III. QUADRATIC FUNCTIONS
    A.  Solving quadratic equations by completing the square, factoring and using the quadratic formula
    B.  Quadratic functions in general or standard (vertex) form
    C.  The vertex and intercepts of quadratic functions
    D.  Graphs of quadratic functions

IV.  POWER FUNCTIONS
    A.  The properties of exponents and simplifying exponential expressions
    B.  Graphs of power functions
    C.  Applications of power functions to real world phenomena

V.   FUNCTION OPERATIONS
    A.  Adding, subtracting, multiplying and dividing functions
    B.  Function composition
    C.  Domain, range and interval notation

VI.  GRAPHS OF FUNCTIONS
    A.  Even and odd functions
    B.  Graphs and symmetry
    C.  Rigid transformations (reflections and translations) of graphs
    D.  One-to-one functions
    E.  Inverse functions

VII. EXPONENTIAL FUNCTIONS
    A.  Solve basic exponential equations by equalization of bases
    B.  Graphs of exponential functions
    C.  Applications of exponential functions including exponential growth and decay
    D.  Applications of logistic growth*

VIII. LOGARITHMIC FUNCTIONS
    A.  The definition of a logarithm
    B.  Translate between exponential and logarithmic forms
    C.  The natural logarithm, base 10 logarithm and other bases
    D.  Exponential and logarithmic equations
    E.  Graphs of logarithmic functions

F. The inverse relationship between exponential and logarithmic functions

G. Doubling time and half-life applications

IX. POLYNOMIAL FUNCTIONS (Student should review factoring on their own as they will be expected to factor polynomials using any of the methods learned in Math 1200)
  A. Degree of a polynomial and a review of factoring
  B. Graphs of polynomial functions and the effects of even or odd degree and the leading coefficient
  C. Find the zeros of polynomial functions by factoring
  D. Long division (synthetic division is optional) and the Rational Roots Theorem
  E. Multiplicity of zeros and the effects on polynomial graphs

X. RATIONAL FUNCTIONS
  A. Rewriting rational functions using long division
  B. Rewriting rational functions using synthetic division*
  C. Graphs of rational functions
  D. Domain, intercepts and vertical, horizontal and slant asymptotes

XI. RIGHT TRIANGLES
  A. The Pythagorean theorem
  B. Definition of sine, cosine and tangent of an angle
  C. Solve right triangles including using the trigonometric inverse functions on a calculator
  D. 30/60/90 triangle
  E. 45/45/90 triangle
  F. Sine and Cosine of 0, 30, 45, 60 and 90 degree angles
  G. Angles in standard position and finding the sine or cosine of the angle
  H. Convert an angle given in degrees to one in radian measure

XII. PERIODIC FUNCTIONS
  A. The unit circle and values of sine and cosine on the unit circle
  B. The basic sine and cosine graphs
  C. The periodic nature of sine and cosine
  D. Combinations of amplitude and period adjustments with phase and vertical shifts
  E. Given a periodic graph, express it using a sine or cosine function
  F. Model periodic phenomena using either a sine or cosine function

*Optional