MATH 1113: Precalculus

MATH 1113 is a combination of the curricula from MATH 1111 (College Algebra) and MATH 1112 (Trigonometry). Bullet points without links are works-in-progress.

Chapter 1: Prerequisites

1.1 REAL NUMBERS: ALGEBRA ESSENTIALS

- Classifying Real Numbers
- Perform Calculations Using Order of Operations
- Using the commutative, associative, distributive, associative, inverse, and identity properties
- Evaluating algebraic expressions
- Simplify algebraic expressions

1.2 EXPONENTS AND SCIENTIFIC NOTATION

- Use the product rule of exponents
- Use the quotient rule of exponents
- Use the power rule of exponents
- Use the zero exponent rule of exponents
- Use the negative rule of exponents
- Find the power of a product and a quotient
- Simplify exponential expressions
- Use scientific notation

1.3 RADICALS AND RATIONAL EXPRESSIONS

- Evaluate Square roots
- Use the product rule to simplify square roots
- Use the quotient rule to simplify square roots
- Add and subtract square roots
- Rationalize denominators
- Use rational exponents

1.4 POLYNOMIALS
- Identify the degree and leading coefficient of polynomials
- Add and subtract polynomials
- Multiply polynomials
- Use FOIL to multiply binomials

1.5 FACTORING POLYNOMIALS

- Factor the greatest common factor of a polynomial
- Factor a trinomial
- Factor by grouping
- Factor a perfect square trinomial
- Factor a difference of squares
- Factor a sum and difference of cubes
- Factor expressions using fractional or negative exponents

Chapter 2: Equations and Inequalities

2.1 THE RECTANGULAR COORDINATE SYSTEMS AND GRAPHS

- Plot ordered pairs in a Cartesian coordinate system
- Graph equations by plotting points
- Graph equations with a graphing utility
- Find x-intercepts and y-intercepts
- Use the distance formula
- Use the midpoint formula

2.2 LINEAR EQUATIONS IN ONE VARIABLE

- Solve equations in one variable algebraically
- Solve a rational equation
- Find a linear equation (point and slope / two points)
- Given the equations of two lines, determine whether their graphs are parallel or perpendicular
- Write the equation of a line parallel or perpendicular to a given line
2.3 MODELS AND APPLICATIONS

- Set up a linear equation to solve a real-world application
- Use a formula to solve a real-world problem

2.4 COMPLEX NUMBERS

- Add and subtract complex numbers
- Multiply and divide complex numbers
- Simplify powers of i

2.5 QUADRATIC EQUATIONS

- Solve quadratic equations by factoring
- Solve quadratic equations by the square root property
- Solve quadratic equations by completing the square
- Solve quadratic equations by using the quadratic formula
- Solve quadratic equations with complex numbers

2.6 OTHER TYPES OF EQUATIONS

- Solve equations involving radicals (single radical, multiple radicals)
- Solve equations using factoring
- Solve radical equations
- Solve absolute value equations
- Solve other types of equations (rational)

2.7 LINEAR INEQUALITIES AND ABSOLUTE VALUE INEQUALITIES

- Use interval notation
- Use properties of inequalities (addition, multiplication)
- Solve inequalities in one variable algebraically
- Solve absolute value inequalities
- Compound Inequalities (and inequalities / or inequalities)

11.1 SYSTEMS OF LINEAR EQUATIONS: TWO VARIABLES
- Solve systems of equations by graphing
- Solve systems of equations by substitution
- Solve systems of equations by addition (elimination)
- Identify inconsistent systems of equations containing two variables
- Express the solution of a system of equations containing two variables

11.3 SYSTEMS OF NONLINEAR EQUATIONS AND INEQUALITIES: TWO VARIABLES

- Solve a system of nonlinear equations using substitution
- Solve a system of nonlinear equations using elimination
- Graph a nonlinear inequality (Quadratic)
- Graph a system of nonlinear inequalities

Chapter 3: Functions

3.1 FUNCTIONS AND FUNCTION NOTATION

- Determining whether a relation represents a function
- Find the value of a function
- Determine whether a function is one-to-one
- Use the vertical line test to identify functions
- Use the horizontal line test to identify one-to-one functions
- Graph the functions in the library of functions

3.2 DOMAIN AND RANGE

- Find the domain of a function identified by an equation
- Find the range of a function
- Domain and Range with a graph
- Graph piecewise-defined functions

3.3 RATES OF CHANGE AND BEHAVIOR OF GRAPHS

- Find the average rate of change of a function on an interval
- Use a graph to determine where a function is increasing, decreasing, or constant
- Analyzing the library of functions for increasing and decreasing intervals
- Use a graph to locate the absolute maximum and absolute minimum

### 3.4 COMPOSITION OF FUNCTIONS

- Combine functions using algebraic operations (addition, subtraction, multiplication, division)
- Create a function by composition of functions
- Evaluate composite functions (formula, table, graph)
- Find the domain of a composite function
- Decomposing a composite function into its component functions

### 3.5 TRANSFORMATION OF FUNCTIONS

- Graph functions using horizontal and vertical shifts
- Graph functions using reflections about the axes
- Graph functions using stretches and compressions
- Perform a sequence of transformations

### 3.6 ABSOLUTE VALUE FUNCTIONS

- Graph the absolute value function

### 3.7 INVERSE FUNCTIONS

- Verify that two functions are inverses
- Find domain and range of inverse functions
- Find and evaluate inverse functions (linear, quadratic, radical, rational)
- Find inverse functions and their graphs

#### Chapter 4: Linear Functions

##### 4.1 LINEAR FUNCTIONS
• Represent a linear function
• Determine whether a linear function is increasing, decreasing, or constant
• Interpret slope as a rate of change
• Write and interpret an equation for a linear function
• Model real-world problems with linear functions
• Graph linear functions
• Write the equation for a function from the graph of a line

4.2 MODELING WITH LINEAR FUNCTIONS

• Build linear models from verbal descriptions

4.3 FITTING LINEAR MODELS TO DATA

• Draw and interpret scatter diagrams
• Use a graphing utility to find the line of best fit
• Distinguish between linear and nonlinear relations
• Fit a regression line to a set of data and use the linear model to make predictions

Chapter 5: Polynomial and Rational Functions

5.1 QUADRATIC FUNCTIONS

• Recognize characteristics of parabolas
• Find domain and range of a quadratic function
• Determine a quadratic function’s maximum or minimum value

5.2 POWER FUNCTIONS AND POLYNOMIAL FUNCTIONS

• Identify polynomial functions
• Identify the degree and leading coefficient of a polynomial function

5.3 GRAPHS OF POLYNOMIAL FUNCTIONS

• Use factoring to find zeros of polynomial functions
- Identify zeros and their multiplicities
- Determine end behavior for polynomial functions
- Graph polynomial functions
- Use the intermediate value theorem

5.4 DIVIDING POLYNOMIALS

- Use long division to divide polynomials
- Use synthetic division to divide polynomials

5.5 ZEROS OF POLYNOMIAL FUNCTIONS

- Evaluate a polynomial using the remainder theorem
- Use the factor theorem to solve a polynomial equation
- Use the rational zero theorem to find rational zeros
- Find the zeros of polynomial functions
- Use the Fundamental Theorem of Algebra
- Use the linear factorization theorem to find polynomials with given zeros
- Use Descartes’ Rule of Signs

5.6 RATIONAL FUNCTIONS

- Use arrow notation (local behavior)
- Find domain of rational functions
- Identify vertical asymptotes of rational functions
- Identify horizontal asymptotes of rational functions
- Identify slant (oblique) asymptotes of rational functions
- Graph rational functions
- Write rational functions

5.7 INVERSES AND RADICAL FUNCTIONS

- Find the inverse of a polynomial function (linear, quadratic)
- Restrict the domain to find the inverse of a polynomial function

5.8 MODELING USING VARIATION
• Solve direct variation problems
• Solve inverse variation problems
• Solve problems involving joint variation

Chapter 6: Exponential and Logarithmic Functions

6.1 EXPONENTIAL FUNCTIONS

• Identify exponential functions
• Evaluate exponential functions
• Find equations of exponential functions
• Apply compound interest formula
• Continuous growth/decay

6.2 GRAPHS OF EXPONENTIAL FUNCTIONS

• Graph exponential functions
• Graph transformations of exponential graphs

6.3 LOGARITHMIC FUNCTIONS

• Convert from logarithmic to exponential form
• Convert from exponential to logarithmic form
• Use common logarithms
• Use natural logarithms

6.4 GRAPHS OF LOGARITHMIC FUNCTIONS

• Find the domain of a logarithmic function
• Graph logarithmic functions
• Graph transformations of logarithmic functions

6.5 LOGARITHMIC PROPERTIES

• Use the product rule for logarithms
• Use the quotient rule for logarithms
Use the power rule for logarithms
Expand logarithmic expressions
Condense logarithmic expressions
Use the change of base formula for logarithms

6.6 EXPONENTIAL AND LOGARITHMIC EQUATIONS

Use like bases to solve exponential equations
Solve exponential equations using logarithms
Use the definition of logarithm to solve logarithmic equations
Use one-to-one property of logarithms to solve logarithmic equations
Solve applied problems using exponential and logarithmic equations

6.7 EXPONENTIAL AND LOGARITHMIC MODELS

Model exponential growth and decay
Use logistic growth models
Choose an appropriate model for data

6.8 FITTING EXPONENTIAL MODELS TO DATA

Build an exponential model from data
Build a logarithmic model from data
Build a logistic model from data

MATH 1112: Trigonometry/MATH 1113: Precalculus

Chapter 7: The Unit Circle: Sine and Cosine Functions

7.1 ANGLES
- Draw angles in standard position
- Introduction to radians
- Radians and Quadrants
- Converting between radians and degrees (introduction)
- Converting degrees to radians
- Add angles in DMS form
- Subtract angles in DMS form
- Find coterterial Angles using degrees (example 1 and 2)
- Find coterterial angles using radians
- Length of an arc that subtends a central angle
- Area of a sector given a central angle

### 7.2 RIGHT TRIANGLE TRIGONOMETRY

- SOHCAHTOA – Part 1 (Introduction), Part 2 (More examples)
- Solve for a side in a right triangle
- Basic cofunction identities
- The Trigonometric Pythagorean Identity (derivation)
- Finding the six trigonometric functions of an angle in a right triangle
- Application (Find the height of a tree)
- Application (A ladder problem)

### 7.3 UNIT CIRCLE

- Introduction to the unit circle
- Trigonometric values of 45 degree angles
- Use the trigonometric Pythagorean identity
- Find reference angles using degrees
- Find reference angles using radians
- Use reference angles to evaluate sine, cosine and tangent

### 7.4 THE OTHER TRIGONOMETRIC FUNCTIONS

- Recognize and use fundamental identities
- Even-odd properties of trigonometric functions
- Use reference angles to evaluate secant and cosecant
Chapter 8: Periodic Functions

8.1 GRAPHS OF THE SINE AND COSINE FUNCTIONS

- Graph of sine function
- Find the amplitude and period
- Find the amplitude, period (plus graphing)
- Graph basic sinusoidal functions without translations
- Graph a sinusoidal function

8.2 GRAPHS OF THE OTHER TRIGONOMETRIC FUNCTIONS

- Analyze the graph of $y=\tan(x)$
- Graph a tangent function
- Analyze the graphs of $y=\csc(x)$ and $y=\sec(x)$
- Graph a secant function
- Graph a cosecant function
- Graph a cotangent function

8.3 INVERSE TRIGONOMETRIC FUNCTIONS

- Introduction to inverse trigonometric functions
- Evaluate inverse trigonometric functions
- Example of solving a right triangle given one side and an angle
- Example of solving a right triangle given two sides
- Find exact values of composite functions with inverse trig functions
- More examples of finding exact values of composite functions with inverse trig functions

Chapter 9

9.1 SOLVING TRIGONOMETRIC EQUATIONS WITH IDENTITIES
- Simplifying trigonometric expressions

9.2 SUM AND DIFFERENCE IDENTITIES
- Use the sum and difference formulas for cosine, sine and tangent

9.3 DOUBLE-ANGLE, HALF-ANGLE, AND REDUCTION FORMULAS
- Use the half-angle formulas
- Use double angle formulas
- Use reduction formulas

9.4 SUM-TO-PRODUCT AND PRODUCT-TO-SUM IDENTITIES
- Express products as sums and sums as products

9.5 SOLVING TRIGONOMETRIC EQUATIONS
- Solving trigonometric equation using identities and factoring
- Solve a trigonometric equation in sine or cosine
- Solve a trigonometric equation in tangent

Chapter 10
10.1 NON-RIGHT TRIANGLES: LAW OF SINES
- Use Law of Sines to solve for a side or an angle
- Find the area of an oblique triangle using the sine function

10.2 NON-RIGHT TRIANGLES: LAW OF COSINES
- Use Law of Cosines to solve for a side or an angle
- Use Heron’s formula to find the area of a triangle

10.3 POLAR COORDINATES
- Plotting polar coordinates and converting between polar and rectangular coordinates

10.5 POLAR FORM OF COMPLEX NUMBERS

- Plot complex numbers in the complex plane
- Find the absolute value of a complex number
- Write complex numbers in polar form
- Find product and quotient of complex numbers in polar form
- Finding powers of complex numbers in polar form
- Finding roots of complex numbers in polar form

10.8 VECTORS

- View vectors geometrically and algebraically
- Find magnitude and direction of a vector
- Find vector addition, scalar multiplication and dot product
- Find the unit vector in the direction of a given vector