

## WTCS Repository

# 10-804-197 College Algebra & Trig w Apps

## Course Outcome Summary

### Course Information

**Description** This course covers those skills needed for success in Calculus and many application areas on a baccalaureate level. Topics include the real and complex number systems, polynomials, exponents, radicals, solving equations and inequalities (linear and nonlinear), relations and functions, systems of equations and inequalities (linear and nonlinear), matrices, graphing, conic sections, sequences and series, combinatorics, and the binomial theorem.

**Total Credits** 5.00

### Pre/Corequisites

**Prerequisite** Each Wisconsin Technical College determines the General Education course prerequisites used by their academic institution. If prerequisites for a course are determined to be appropriate, the final Course Outcome Summary must identify the prerequisites approved for use by the individual Technical College.

### Course Competencies

#### 1. Apply mathematical problem solving skills.

##### Assessment Strategies

- 1.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 1.2. by participating actively in class discussions and activities.

##### Criteria

*Your performance will be successful when:*

- 1.1. you show work in a clear and logical manner.
- 1.2. you verify solutions.
- 1.3. you verify that the solution is within the stated range and reflect appropriate accuracy or precision.
- 1.4. you label solutions with appropriate units.

#### 2. Use the fundamental concepts of algebra.

##### Assessment Strategies

- 2.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 2.2. by participating actively in class discussions and activities.

##### Criteria

*Your performance will be successful when:*

- 2.1. you apply properties of real numbers.
- 2.2. you locate real numbers on the number line.
- 2.3. you evaluate expressions using absolute value.

- 2.4. you relate absolute value to distances on the number line.
- 2.5. you represent absolute value expressions without the use of the absolute value.
- 2.6. you model a problem situation algebraically.
- 2.7. you apply positive integer exponents, negative integer exponents, and rational number exponents to evaluation and simplification of expressions.
- 2.8. you relate roots to rational number exponents.
- 2.9. you define monomial, binomial, trinomial, and polynomial.
- 2.10. you perform algebraic operations on polynomials.
- 2.11. you apply the binomial theorem to expand powers of binomials.
- 2.12. you factor polynomials.

### **3. Analyze the features of a graph of a given function or relation.**

#### **Assessment Strategies**

- 3.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 3.2. by participating actively in class discussions and activities.

#### **Criteria**

*Your performance will be successful when:*

- 3.1. you use the Cartesian coordinate system.
- 3.2. you find distances in the Cartesian coordinate system.
- 3.3. you use function notation correctly.
- 3.4. you graph a relation or function in X and Y.
- 3.5. you differentiate between symmetry about the X-axis, the Y-axis, and the origin.
- 3.6. you determine the intercept of a graph.
- 3.7. you apply the vertical line test to distinguish between a relation and a function.
- 3.8. you define a relation or function.
- 3.9. you determine the domain and range of a relation or function.
- 3.10. you define a 1-1 function.
- 3.11. you apply the horizontal line test for 1-1.
- 3.12. you determine the inverse function of a 1-1 function.
- 3.13. you specify the relation between the domain and the range of a function and its inverse.

### **4. Solve linear and quadratic equations and inequalities.**

#### **Assessment Strategies**

- 4.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 4.2. by participating actively in class discussions and activities.

#### **Criteria**

*Your performance will be successful when:*

- 4.1. you define a linear function, a linear equation, and a linear inequality.
- 4.2. you define a solution of an equation.
- 4.3. you relate the solution of an equation to the X-intercept of a graph of the function and to the root (or zero) of the function.
- 4.4. you distinguish between an identity and a conditional equation.
- 4.5. you define equivalent equations and inequalities.
- 4.6. you solve linear equations and inequalities (with or without absolute values) algebraically.
- 4.7. you solve linear equations and inequalities (with or without absolute values) graphically.
- 4.8. you define quadratic equations.
- 4.9. you solve quadratic equations using: graphical methods, factoring, completing the square, and the quadratic formula.
- 4.10. you solve 2nd or higher order equations or inequalities algebraically or graphically.
- 4.11. you model a verbal problem with an algebraic representation and a graph.
- 4.12. you solve the algebraic representation of a verbal problem.
- 4.13. you interpret the algebraic answer to a verbal problem in terms of the original problem.
- 4.14. you use the equivalent interval notation, absolute value notation, and/or inequality notation when writing solutions of inequalities.

## 5. Analyze the properties of linear and quadratic functions.

### Assessment Strategies

- 5.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 5.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 5.1. you determine slope, X-intercept, and Y-intercept.
- 5.2. you relate slope to parallel and perpendicular lines.
- 5.3. you use point-slope, slope-intercept, and standard forms of the equation of a line.
- 5.4. you convert between point-slope, slope-intercept, and standard forms of the equation of a line.
- 5.5. you use the midpoint formula.
- 5.6. you find the equation of a line that is parallel to or perpendicular to a given line through a specified point.
- 5.7. you find the equation of the perpendicular bisector of a given line segment.
- 5.8. you prove geometric theorems algebraically.
- 5.9. you graph quadratic functions.
- 5.10. you apply the concepts of vertically stretching or shrinking or shrinking, reflecting, or shifting a graph of a quadratic to transform the graph.
- 5.11. you determine the sum, difference, product, and quotient of two functions.
- 5.12. you determine the composition of two functions.
- 5.13. you note that function composition is non-commutative.
- 5.14. you apply geometric transformations as compositions.
- 5.15. you determine the vertex, axis of symmetry, and direction from the standard form of a quadratic function.
- 5.16. you change the form of a quadratic function to a standard form.
- 5.17. you find zeros of quadratic functions algebraically and graphically.

## 6. Use theories of equations to find the zeros of a polynomial function.

### Assessment Strategies

- 6.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 6.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 6.1. you define the degree of a polynomial function.
- 6.2. you identify local maxima and minima of a polynomial function using graphical and analytical methods.
- 6.3. you determine whether a function is increasing or decreasing on an interval.
- 6.4. you apply the concepts of continuity, discontinuity, the intermediate value theorem, and the bisection method of finding a zero to determine the features of a graph.
- 6.5. you determine the behavior of a polynomial function at the end points of its domain.
- 6.6. you apply transformations to polynomial functions.
- 6.7. you apply the remainder theorem, the factor theorem, the rational roots theorem, synthetic division, the upper and lower bounds theorem, and Descartes' law of signs to find zeros of a polynomial function.
- 6.8. you use the fundamental theorem of algebra to determine the number of roots of a polynomial equation.
- 6.9. you use graphical methods to estimate the roots of a polynomial equation.

## 7. Determine complex solutions to polynomial equations.

### Assessment Strategies

- 7.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 7.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 7.1. you define the imaginary unit  $i$ .
- 7.2. you define complex numbers and complex conjugates.

- 7.3. you perform operations with complex numbers including addition, subtraction, multiplication, and division.
- 7.4. you apply the fundamental theorem of algebra and the linear factorization theorem to determine solutions to polynomial equations.
- 7.5. you find complex (non-real) solutions to polynomial equations.

## 8. Perform computations with rational functions.

### Assessment Strategies

- 8.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 8.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 8.1. you define a rational expression.
- 8.2. you recognize a rational expression.
- 8.3. you simplify rational expressions.
- 8.4. you add, subtract, multiply and divide rational expressions.
- 8.5. you simplify complex fractions.
- 8.6. you define a rational function and the domain of a rational function.
- 8.7. you find vertical, horizontal, and oblique asymptotes.
- 8.8. you discuss the properties of  $f(x) = 1/x$ , graph it and apply transformations to rational functions.
- 8.9. you determine the behavior of rational functions as the absolute value of the variables becomes large.
- 8.10. you identify removable discontinuities.
- 8.11. you determine the end behavior for rational functions where the degree of the numerator does not exceed the degree of the denominator.
- 8.12. you graph rational functions.
- 8.13. you solve rational functions algebraically and graphically.
- 8.14. you discuss extraneous solutions.

## 9. Perform computations with radical functions.

### Assessment Strategies

- 9.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 9.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 9.1. you define radical, index, and radicand.
- 9.2. you define principal square root, cube root, nth root.
- 9.3. you determine the domain of radical expression.
- 9.4. you solve radical equations algebraically and check for extraneous roots.

## 10. Analyze exponential and logarithmic functions.

### Assessment Strategies

- 10.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 10.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 10.1. you define base and exponent.
- 10.2. you define the exponential function with base 10, base 2, fractional base, an arbitrary base, and base e.
- 10.3. you graph the exponential function with base 10, base 2, fractional base, an arbitrary base, and base e.
- 10.4. you apply transformations to exponential functions.
- 10.5. you apply exponential functions to such problems as exponential growth and decay, half-life, interest, annuities, and mortgages.
- 10.6. you solve exponential equations algebraically and graphically.
- 10.7. you define logarithmic functions with base a- also discuss possible values for the base.

- 10.8. you define the common logarithmic function and the natural logarithmic function.
- 10.9. you discuss the inverse relationship between the logarithmic function and the exponential function (same base).
- 10.10. you determine the domain and range of logarithmic functions.
- 10.11. you produce the graph of a logarithmic function (with various bases) considering the domain and the range.
- 10.12. you solve exponential and logarithmic functions algebraically and graphically.

## 11. Solve non-linear systems of equations.

### Assessment Strategies

- 11.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 11.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 11.1. you solve a nonlinear system of equations algebraically.
- 11.2. you use graphing calculator to solve non-linear systems of equation.
- 11.3. you use nonlinear systems of equation to solve applied problems.

## 12. Solve systems of linear equations.

### Assessment Strategies

- 12.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 12.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 12.1. you solve systems of linear equations in three or more variables algebraically.
- 12.2. you use the graphing calculator to solve systems of linear equations in three or more variables.
- 12.3. you use systems of three equations to solve applied problems.

## 13. Perform basic operations with matrices.

### Assessment Strategies

- 13.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 13.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 13.1. you add matrices.
- 13.2. you subtract matrices.
- 13.3. you multiply a matrix by a scalar.
- 13.4. you multiply matrices when possible.
- 13.5. you solve application problems using basic operations with matrices.
- 13.6. you perform basic operations with matrices using the graphing calculator.

## 14. Use the inverse of a square matrix.

### Assessment Strategies

- 14.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 14.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 14.1. you recognize the identity matrix of a square matrix.
- 14.2. you recognize when two square matrices are inverses of one another.
- 14.3. you find the inverse of a square matrix, if it exists.

- 14.4. you use inverses of matrices to solve systems of equations.
- 14.5. you solve application problems involving matrix inverses.
- 14.6. you use a graphing calculator to compute matrix inverses.

## 15. Solve systems of equations using matrix equations.

### Assessment Strategies

- 15.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 15.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 15.1. you identify a matrix equation.
- 15.2. you write matrix equations as a system of linear equations.
- 15.3. you write a system of linear equations as a matrix equation.
- 15.4. you find the solution of a system of linear equations by using inverses of matrices.
- 15.5. you solve application problems using systems of linear equations and matrix equations.

## 16. Solve systems of linear inequalities.

### Assessment Strategies

- 16.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 16.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 16.1. you graph linear inequalities algebraically.
- 16.2. you graph systems of linear inequalities algebraically.

## 17. Produce the graph of a conic section.

### Assessment Strategies

- 17.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 17.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 17.1. you distinguish between the type of conic sections produced when a quadratic polynomial in two unknowns is graphed.
- 17.2. you find the center and the semi-major and semi-minor axes given the polynomial form of the equation of an ellipse.
- 17.3. you find the center, the axes, and the asymptotes given the polynomial form of the equation of a hyperbola.
- 17.4. you find the center, the axis, and the directrix given the polynomial form of the equation for a parabola.
- 17.5. you sketch the graph of a conic section given its equation in polynomial form.

## 18. Solve problems involving sequences and series.

### Assessment Strategies

- 18.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 18.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 18.1. you find terms of sequences given the  $n$ th term.
- 18.2. you find a general term for a sequence.
- 18.3. you convert between sigma notation and other notation for a series.
- 18.4. you find the  $n$ th term of an arithmetic and geometric sequence.

- 18.5. you find the common difference of an arithmetic sequence.
- 18.6. you construct an arithmetic and geometric sequence.
- 18.7. you find the common ratio of a geometric sequence.
- 18.8. you find the sum of the first  $n$  terms of an arithmetic and geometric sequence.
- 18.9. you find the sum of an infinite geometric series, if it exists.

## 19. Use the Binomial Theorem.

### Assessment Strategies

- 19.1. by submitting all in-class and take home assignments with passing grades according to the grading scale in the syllabus.
- 19.2. by participating actively in class discussions and activities.

### Criteria

*Your performance will be successful when:*

- 19.1. you expand a power of a binomial using Pascal's triangle or factorial notation.
- 19.2. you find a specific term of binomial expansion.

## 20. Define the trigonometric functions.

### Assessment Strategies

- 20.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 20.1. you graph angles in standard position.
- 20.2. you solve problems involving special right triangles.
- 20.3. you use trigonometric functions defined by using a point on the terminal side of an angle.
- 20.4. you use the trigonometric functions defined on the basis of a right triangle.
- 20.5. you prove simple trigonometric identities.
- 20.6. you use degree-measures of angles including decimals as well as minutes and seconds.

## 21. Evaluate the trigonometric functions.

### Assessment Strategies

- 21.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 21.1. you identify exact values of trigonometric functions where appropriate.
- 21.2. you find approximate values of trigonometric functions using a calculator.
- 21.3. you use inverse trigonometric calculator functions to find measures of acute angles.
- 21.4. you solve right triangles using trigonometric functions and other properties of such triangles.
- 21.5. you use vectors applying a geometric approach.

## 22. Use radian measures of angles.

### Assessment Strategies

- 22.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 22.1. you use the concept of a reference angle.
- 22.2. you relate radian measures to real numbers.
- 22.3. you convert between radian measures and degree measures of angles.
- 22.4. you find exact and approximate values of angles described in radians.
- 22.5. you use trigonometric function defined for the unit circle.
- 22.6. you use the concept arc length and area of a sector.
- 22.7. you use the concepts of linear velocity and angular velocity.
- 22.8. you convert between linear velocity and angular velocity.

## **23. Interpret graphs of trigonometric functions.**

### **Assessment Strategies**

23.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### **Criteria**

*Your performance will be successful when:*

- 23.1. you use basic graphs of trigonometric functions.
- 23.2. you identify domains and ranges of trigonometric functions using correct notation.
- 23.3. you identify undefined and restricted values for each basic trigonometric function.
- 23.4. you use concept of amplitude, period, and phase shift related to the graphs of trigonometric functions.

## **24. Graph equations of basic and modified trigonometric functions.**

### **Assessment Strategies**

24.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### **Criteria**

*Your performance will be successful when:*

- 24.1. you sketch graphs of one period of basic trigonometric functions clearly and accurately.
- 24.2. you graph equations of trigonometric functions with variations in amplitude and/or period and with/without phase shifts.
- 24.3. you find equations from graphs of trigonometric functions.

## **25. Define the inverse of a trigonometric function.**

### **Assessment Strategies**

25.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### **Criteria**

*Your performance will be successful when:*

- 25.1. you relate the inverse of trigonometric functions to the functions themselves.
- 25.2. you identify domains and ranges of inverses of trigonometric functions.
- 25.3. you sketch graphs of the inverse of trigonometric functions.
- 25.4. you evaluate the inverse of trigonometric function for given values of the domain.
- 25.5. you find inverse trigonometric function values, with and without a calculator.

## **26. Derive trigonometric identities.**

### **Assessment Strategies**

26.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### **Criteria**

*Your performance will be successful when:*

- 26.1. you use the reciprocal, ratio, Pythagorean and other established identities to derive new identities.
- 26.2. you use the techniques of algebra to prove new identities.

## **27. Apply new trigonometric identities.**

### **Assessment Strategies**

27.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### **Criteria**

*Your performance will be successful when:*

- 27.1. you use sum and difference formulas to evaluate trigonometric function of angles.
- 27.2. you use sum and difference formulas to prove other identities.
- 27.3. you use double-angle and half-angle formulas to evaluate trigonometric functions of angles.
- 27.4. you use double-angle and half-angle formulas to prove other identities.
- 27.5. you use sum-to-product and product-to-sum formulas to prove other identities.



## 28. Solve trigonometric equations.

### Assessment Strategies

28.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 28.1. you use algebraic techniques and trigonometric identities to solve equations involving trigonometric expressions of a single angle.
- 28.2. you use algebraic techniques and trigonometric identities to solve equations involving trigonometric functions of multiple angles.

## 29. Perform operations with parametric equations.

### Assessment Strategies

29.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 29.1. you eliminate the parameter from a pair of parametric equations.
- 29.2. you sketch the graphs which result from eliminating the parameter from a pair of parametric equations.

## 30. Solve oblique triangles.

### Assessment Strategies

30.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 30.1. you use the Law of Sines, the Law of Cosines, and properties of triangles to solve oblique triangles.
- 30.2. you calculate areas of oblique triangles using formulas that involve trigonometric functions.
- 30.3. you calculate areas of oblique triangles for which the lengths of all sides are known.
- 30.4. you solve application problems by solving oblique triangles.

## 31. Perform vector operations.

### Assessment Strategies

31.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 31.1. you define a vector algebraically.
- 31.2. you define unit vectors  $i$  and  $j$ .
- 31.3. you identify the horizontal and vertical components of a vector.
- 31.4. you find the magnitude of a vector.
- 31.5. you add and subtract algebraic vectors.
- 31.6. you perform scalar multiplication of vectors.
- 31.7. you obtain dot product of vectors.
- 31.8. you determine if two vectors are perpendicular or not.
- 31.9. you find the angle between two vectors.

## 32. Use trigonometry in vector applications.

### Assessment Strategies

32.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

### Criteria

*Your performance will be successful when:*

- 32.1. you find the resultant of the combination of vectors.
- 32.2. you apply trigonometry to vector applications such as physics or engineering.

### **33. Perform operations with complex numbers in trigonometric form.**

#### **Assessment Strategies**

33.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

#### **Criteria**

*Your performance will be successful when:*

- 33.1. you transform complex numbers from rectangular form to trigonometric form and vice versa.
- 33.2. you graph complex numbers in trigonometric form and rectangular form.
- 33.3. you find products and quotients of complex numbers written in trigonometric form.
- 33.4. you find powers and roots of complex numbers written in trigonometric form.
- 33.5. you summarize DeMoivre's theorem.
- 33.6. you use DeMoivre's theorem to find powers and roots of complex numbers.

### **34. Relate the polar coordinate system to the rectangular coordinate system.**

#### **Assessment Strategies**

34.1. By a satisfactory score on all tests, quizzes, and/or graded assignments incorporating this competency.

#### **Criteria**

*Your performance will be successful when:*

- 34.1. you represent a point on the plane in both rectangular and polar coordinates.
- 34.2. you convert an equation in polar coordinates to rectangular coordinates and vice versa.
- 34.3. you graph equations in polar form.