

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

MATHEMATICS 176 – PRECALCULUS: FUNCTIONS AND GRAPHS

6 hours lecture, 6 units

Catalog Description

Preparation for calculus: polynomial, absolute value, radical, rational, exponential, logarithmic, and trigonometric functions and their graphs; analytic geometry, polar coordinates. *Successful completion of MATH 176 is equivalent to the successful completion of MATH 170 and 175. Maximum of 7 units can be earned for successfully completing any combination of MATH 170, 175, 176.*

Prerequisite

Appropriate placement or Intermediate Algebra

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Identifying and/or Simplifying:
 - a. Linear, quadratic, rational, radical, absolute value, exponential and logarithmic equations
 - b. Polynomial expressions
 - c. Rational expressions
 - d. Algebraic expressions involving radicals and/or rational exponents
 - e. Logarithmic expressions
 - f. Complex numbers
 - g. Basic mathematical formulas from related disciplines
- 2) Solving:
 - a. Algebraic equations
 - b. Logarithmic and exponential equations
 - c. Systems of equations and inequalities
 - d. Applications from a variety of disciplines
- 3) Graphing, Transforming and/or Operating on the following:
 - a. Polynomial, absolute value, exponential and logarithmic functions and their inverses
 - b. Linear and quadratic inequalities
 - c. Systems of equations and inequalities
- 4) Factoring Polynomials
- 5) Functions:
 - a. Determine the domain and range
 - b. Find the inverse
 - c. Perform basic operations
- 6) Geometry:
 - a. Formulas for geometric objects
 - b. Properties of geometric figures
- 7) Mathematical Reasoning and Problem Solving:
 - a. Inductive and deductive reasoning
 - b. Effective communication of mathematical arguments

Course Content

- 1) Linear, quadratic, polynomial, rational, absolute value, exponential, logarithmic, piecewise-defined and trigonometric functions, graphs and inverses
- 2) Graphic, numeric and analytic methods to solve application problems including linear, quadratic, polynomial, rational, absolute value, exponential, logarithmic, trigonometric equations and systems of equations
- 3) Polynomial and rational functions and equations including the use of graphing utilities and synthetic division to graph
- 4) Trigonometric functions developed from the unit circle using radian and degree measure
- 5) Trigonometric identities
- 6) Graphic, numeric and analytical methods to solve linear and non-linear systems of equations and inequalities
- 7) Matrices and determinants
- 8) Sequences and series
- 9) Binomial theorem
- 10) Mathematical induction
- 11) Conics, parametric equations and polar coordinates
- 12) Vectors in a plane
- 13) Historical contributions of number and mathematical theories and concepts from diverse cultures

Course Objectives

Students will be able to:

- 1) Define all six trigonometric functions in terms of a triangle, the coordinate system and the unit circle.
- 2) Compute angles and sides of triangles in terms of degree or radian measure.
- 3) Graph trigonometric functions and their inverse functions, and discuss the domain, range and properties of these functions.
- 4) Prove trigonometric identities and apply trigonometric identities to solve for exact values, simplify expressions and solve equations.
- 5) Calculate vector sum, vector products, dot products, vector magnitudes and vector angles.
- 6) Analyze physical problems and create trigonometric relationships involving triangles, the coordinate system, the unit circle or vectors.
- 7) Analyze linear, quadratic, polynomial, rational, absolute value, exponential, logarithmic and piecewise-defined functions as well as inverse functions from a graphic, numeric and analytic perspective.
- 8) Analyze and solve applied problems from various disciplines and involving a variety of equations including but not limited to: linear, quadratic, polynomial, rational, radical, absolute value, exponential and logarithmic equations as well as systems of equations.
- 9) Apply critical thinking and mathematical reasoning skills necessary in collegiate-level algebraic problem solving in related disciplines such as science, business and engineering.
- 10) Classify conic equations and construct graphs of conic sections.
- 11) Observe, interpret and analyze the behavior of graphs of a wide variety of functions and statistical plots.
- 12) Utilize sequences and series equations to solve theoretical and applied problems from various disciplines such as science, business and engineering.
- 13) Select and apply appropriate technology including but not limited to computer programs and graphing utilities to model, analyze and interpret a collection of data or to solve real-world application problems requiring the use of collegiate-level mathematics.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Exploration activities (both independent and group) which measure students' ability to discover how different parameters affect the graphs or behaviors of linear, quadratic, polynomial, rational, absolute value, exponential, to discover how different parameters affect the graphs of trigonometric functions, or how to combine trigonometric relationships to prove a new trigonometric identity. Logarithmic and piecewise-defined functions as well as inverse functions and conic equations.
- 2) Homework assignments which measure students' ability to: compute with and graph a variety of functions and conics as well as construct and carry out a plan to solve a diverse collection of real-world application problems, select and evaluate trigonometric functions, make computations in degrees and radians, create graphs of trigonometric functions, transform an expression with identities, work with and calculate various vector related topics, and construct and carry out a plan to solve trigonometric word problems.
- 3) Exams, including a comprehensive final exam and quizzes which measure students' ability to:
 - a. Calculate and solve with linear, quadratic, polynomial, rational, absolute value, exponential, logarithmic and piecewise-defined functions as well as inverse functions.
 - b. Sketch graphs of linear, quadratic, polynomial, rational, absolute value, exponential, logarithmic and piecewise-defined functions and inverse functions as well as discuss the functions' domain and range; also sketch graphs of conics.
 - c. Construct functions that model collected data or real-world application problems.
 - d. Utilize sequence and series formula to solve for a sequence term, calculate a sum or solve a sequence-related application problem.
 - e. Define and calculate with all six trigonometric functions in degrees and radians, sketch graphs of trigonometric functions as well as discuss the functions' domain and range, construct a logical sequence of transformations which verify trigonometric identities, and break down a physical problem into trigonometric components in order to produce a solution.

Special Materials Required of Student

Graphing calculator

Minimum Instructional Facilities

Smart classroom with whiteboards covering three walls, graphing utility and viewscreen, overhead projector

Method of Instruction

- 1) Lecture and discussion
- 2) Teamwork
- 3) Instructor-guided discovery
- 4) Computer-facilitated instruction

Out-of-Class Assignments

- 1) Problem sets
- 2) Exploratory activities and/or projects
- 3) Reading and/or writing assignments

Texts and References

- 1) Required (representative example): Connolly, Hughes-Hallet, Gleason, et al. *Functions Modeling Change: A Preparation for Calculus*. 6th edition. Wiley, 2019.
- 2) Supplemental: None

Exit Skills

Students having successfully completed this course exit with the following skills, competencies and/or knowledge:

- 1) Identify and/or Perform:
 - a. Domain and range of algebraic and trigonometric functions
 - b. Operations on algebraic and trigonometric functions
 - c. Inverses of algebraic and trigonometric functions
 - d. Operations with complex numbers
 - e. Trigonometric form of complex numbers
- 2) Solve:
 - a. Algebraic and absolute value equations and inequalities
 - b. Logarithmic and exponential equations
 - c. n^{th} order systems of equations and inequalities
 - d. Application problems involving oblique triangles, the Pythagorean Theorem, Law of Sines, Law of Cosines, and vectors
 - e. Trigonometric equations using the basic trigonometric identities
 - f. Application problems from a variety of disciplines
 - g. Application problems involving right triangle trigonometry
- 3) Interpret from a Graphical, Numerical and/or Analytic Perspective:
 - a. Trigonometric functions developed from the unit circle using radian or degree measure
 - b. Inverse trigonometric functions
 - c. Amplitude, period, frequency and phase shift of trigonometric functions
 - d. Algebraic functions and their inverses including: polynomial, radical, rational, absolute value, exponential and logarithmic functions
 - e. Linear and quadratic inequalities
 - f. Systems of equations and inequalities
- 4) Apply inductive and/or deductive reasoning and the basic trigonometric identities to verify other trigonometric identities

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) Interpret graphical information, such as identifying types of functions, translations, inverses, intercepts, and asymptotes.
- 2) Solve inequalities or equations involving algebraic or transcendental functions.
- 3) Construct appropriate models to solve real-world application problems and interpret the results in context.

*For the complete list of **learning objectives**, please see the **Course Objectives** section