Approved by

BOARD OF TRUSTEES

May 12, 2016

San Mateo Union High School District
Course of Study

Pre-Calculus

I. Course Description

A. UC/CSU “a-g” Subject Area: C) Mathematics
B. Rationale for Course: The California state standards in mathematics have changed. We need new courses of study that reflect the changes in content, practice, and rigor. The overall goal will be to increase A-G completion rates. Algebra I, Geometry, and Algebra II are the courses that meet college and career readiness standards in mathematics. Pre - Calculus has standards that are composed mostly of (+) standards, students who enroll in Pre-calculus should have a strong interest in the math and science that they intend to continue to pursue in college.
C. Grade Level: 10 - 12
D. Credits: 10 Math
E. Pre-Requisites: Successful completion of Algebra II
F. Brief Course Description: Pre-calculus combines concepts of trigonometry, geometry, and algebra that are needed to prepare students for the study of calculus. The course strengthens students’ conceptual understanding of problems and mathematical reasoning in solving problems. Facility with these topics is especially important for students who intend to study calculus, physics, other sciences, and engineering in college. The main topics in the Pre-calculus course are complex numbers, rational functions, trigonometric functions and their inverses, inverse functions, vectors and matrices, and parametric and polar curves. Because the standards that comprise this course are mostly (+) standards, students who enroll in Pre-calculus should have met the college- and career-ready standards of the previous courses in the Integrated Pathway or Traditional Pathway. It is recommended that students complete Pre-calculus before taking an Advanced Placement calculus course.

II. Course Purpose: Goals and Student Outcomes

Students demonstrate the mathematical practice standards by:

- Students expand their repertoire of expressions and functions that can be used to solve problems. They grapple with understanding the connection between complex numbers, polar coordinates, and vectors.
- Students understand the connection between transformations and matrices, seeing a matrix as an algebraic representation of a transformation of the plane.

- Students continue to reason through the solution of an equation and justify their reasoning to their peers. They defend their choice of a function to model a real-world situation.
- Students apply their new mathematical understanding to real-world problems. They also discover mathematics through experimentation and by examining patterns in data from real-world contexts.
- Students continue to use graphing technology to deepen their understanding
- of the behavior of polynomial, rational, square root, and
- trigonometric functions.
- Students make note of the precise definition of complex number, understanding
- that real numbers are a subset of complex numbers. They pay attention to units in real-world problems and use unit analysis as a method for verifying answers.
- Students understand that matrices form an algebraic system in which the order of multiplication matters, especially when solving linear systems using matrices. They see that complex numbers can be represented by polar coordinates and that the structure of the plane yields a geometric interpretation of complex multiplication.
- Students multiply several vectors by matrices and observe that some matrices produce rotations or reflections. They compute with complex numbers and generalize the results to understand the geometric nature of their operations.

Students demonstrate the content standards:

- Students will interpret functions that arise in applications in terms of the context.
- Students will analyze functions using different representations.
- Students will build new functions from existing functions.
- Students will extend the domain of trigonometric functions using the unit circle.
- Students will model periodic phenomena with trigonometric functions.
- Students will prove and apply trigonometric identities.
- Students will perform arithmetic operations with complex numbers.
- Students will represent complex numbers and their operations on the complex plane.
- Students will represent and model with vector quantities.
- Students will perform operations on vectors.
- Students will perform operations on matrices and use matrices in applications.
- Students will interpret the structure of expressions.
- Students will rewrite rational expressions.
- Students will create equations that describe numbers or relationships.
- Students will solve systems of equations.

- Students will apply trigonometry to general triangles.
- Students will translate between the geometric description and the equation for a conic section.

III. Course Outline

I. Introduction and Constructions: Constructions with compass, string, mirror, patty paper and/or geometry software. Copy line segments and angles. Construct parallel and perpendicular lines. Construct bisectors, equilateral triangles, squares and hexagons.
II. Basic Definitions, Rigid Motions and Congruence: Develop definitions. Experiment with transformations on a plane. Understand congruence in terms of rigid motion. Specify a sequence of transformations that will carry a given figure onto another. Triangle congruence in terms of rigid motion.
III. Geometric Relationships and Properties: Prove geometric theorems, Prove theorem of lines, angles, triangles, parallograms
IV. Similarity: Understand similarity in term of dilations.
V. Coordinate Geometry: Use coordinates to prove simple geometric theorems algebraically, Slope for parallel and perpendicular lines
VI. Circles and Conics: Equation of a circle, completing the square for equation of a circle, conic section, focus and directrix of a parabola, area and circumference of a circle, chords, angles and arcs, tangents and secants.
VII. Trig Ratios: Sine, cosine and tangent rations, inverses, applications, special right triangles, Pythagorean triples, law of sines, law of cosines
VIII. Modeling: applications of geometric modeling
IX. Probability: Conditional probability, independence, two-way tables, counting, permutations, combinations,

IV. Key Assignments

- Foundational study of functions: Students write equations for and sketch linear, quadratic, polynomial, radical, and absolute value parent functions, then describe and graph transformations of these functions. Students identify the domain, range, and interval behaviors of the graphs and use graphing calculators to determine local maxima and minima. Students algebraically test functions to determine if they are odd, even, or neither and generate inverse functions both algebraically and graphically. Students add, subtract, multiply, divide, and take the composition of functions,--and use the latter to verify if there is an inverse relation between two functions.

- Specific Attributes of Polynomial and Rational Functions: Students use calculators, the rational root test, and factoring to identify the zeros of polynomial functions in accordance with existence theorems. That is, they will include complex numbers in their analysis to determine all of the zeros and recognize that complex zeros present as conjugate pairs.
- Students identify the domain, range, vertical asymptotes, holes, and determine the value(s) for any horizontal asymptotes of rational functions. Students use these attributes of rational functions to sketch their graphs and use the graphing and table features of a graphics calculator to confirm their work.
- Transcendental functions: Students recognize, evaluate, and graph exponential and logarithmic functions. They rewrite logarithms using different bases, use the properties of logarithms to evaluate, rewrite, expand or condense logarithmic expressions for simplifying and solving equations. Work is both done by hand and by using the features of graphing calculators to find answers to exponential and logarithmic equations. They use exponential formulas to determine the balance in financial accounts with compounding interest for different rates, and compounding periods including continual compounding and apply exponential models to predict population growth and radioactive decay.
- Trigonometric Functions: Students convert between degrees and radians and can place these values along the unit circle. Students use all six trigonometric functions (sine, cosine, tangent, secant, cosecant, and cotangent) to solve problems such as those involving elevations, with respect to angles with the ground. Students determine specific angles based on trig values and quadrants; making use of their knowledge of the unit circle and inverse functions on calculators. Students graph trigonometric functions, identifying the appropriate domain, range, period, frequency, phase shift, vertical shift, and amplitude.
- Analytic Trigonometry: Students apply fundamental trigonometric identities to evaluate trig functions, simplify expressions, and verify more complicated identities. They apply double angle, half-angle and sum and difference formulas to find exact trig values. They use the law of sines and cosines to solve for unknown angles and lengths of oblique triangles. Students write the trigonometric form of complex numbers.

V. **Instructional Methods and/or Strategies**

- The teacher sets the tone for the course and provides instruction by modeling the processes in which the topics and problems can be approached and solved.?? Teacher interaction with the students via questioning and observation of warm-ups is commonly employed to check for student understanding. This is typical throughout the delivery of the curriculum.?? Instruction is provided on how to use the graphing calculators as they can be used to validate answers obtained using algebraic means, explore transformations, graph functions, find solutions, maxima, minima, and efficiently perform complicated mathematical operations.?? Students are encouraged to work with other students, utilize the textbook (The text book chapters begin with listed objectives and important vocabulary and the chapters end with identifying review exercises as related to each topic, additional review exercises, and a practice test which has answers in the back.), access the web, and see the teacher during lunch/by appointment if additional support is desired.
- Homework is assigned, almost daily, from the text book. The assignments are intended to allow practice of the computation, conceptualization, and application of material presented in class.
- Typical classroom work/activity includes warm-ups that may employ having students work answers at the board, on white boards, on their calculators, on their own papers, or to discuss the solutions with other students.
- Graphing calculators are used in this course. Students will be using calculators to investigate attributes of algebraic, exponential, logarithmic, and trigonometric functions. Also, to select the correct mode, window, and table adjustments that support proper calculator use.
- Teacher created work sheets may be used to supplement the text book material to support concepts discussed in class and help students focus on the fundamental or key points of the topics.

VI. **Assessment Methods and/or Tools**

Formative assessments will be used with constructed response questions. Each chapter will have a summative exam that includes no more than 50%

new material, projects will be included in the grade and there will be two final exams, one at the end of three weeks, the other at the end of six weeks.

VII. **Textbook(s) and Supplemental Instructional Materials**

Larson, Pearson