MT. DIABLO UNIFIED SCHOOL DISTRICT
COURSE OF STUDY

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COURSE TITLE:	**Algebra II**
COURSE NUMBER:	**1330**
DEPARTMENT:	**High School Mathematics**
LENGTH OF COURSE:	**One Year**
CREDITS PER SEMESTER:	**5**
GRADE LEVEL(S) :	**10-12**
REQUIRED OR ELECTIVE:	**This course fulfills one year of high school mathematics requirement and UC/CSU "c" requirement.**
PREREQUISITES:	**Successful completion of Geometry**
BOARD OF EDUCATION ADOPTION:	~~**June 22, 2010**~~

~~**COURSE DESCRIPTION:**~~
~~This course provides the student with the knowledge, concepts and skills identified in the California State Math Standards for Algebra II. The ability to communicate mathematical reasoning and understanding will be incorporated into all math topics. In addition, students will develop their ability to construct formal, logical arguments in algebraic settings and problems. This course is the third course in the three-year mathematics requirement for four-year college admission.~~

COURSE OVERVIEW

This course extends and deepens students' understanding of numbers and functions. Throughout the course, students will explore the systems of polynomial and rational functions, and their relationship to integers and rational numbers respectively. Students will examine the relationship of a function and its inverse, through exponential and logarithmic functions. Students will study trigonometric functions and expand their knowledge of statistics to include understanding of the normal distribution.

In addition to the California Common Core State Standards for Mathematics, students will experience and gain fluency with the 8 Standards for Mathematical Practice:

1. Make sense of problems and persevere in solving them
2. Reason abstractly and quantitatively
3. Construct viable arguments and critique the reasoning of others
4. Model with mathematics
5. Use appropriate tools strategically
6. Attend to precision

7. Look for and make use of structure
8. Look for and express regularity in repeated reasoning

Overall, the quality of a learning environment depends on the extent to which it provides opportunities for students along the following five dimensions:

1. The richness of disciplinary concepts and practices ("the content") available for learning;
2. Student sense-making and "productive struggle";
3. Meaningful and equitable access to concepts and practices for all students;
4. Means for constructing positive disciplinary identities through presenting, discussion and refining ideas; and
5. The responsiveness of the environment to student thinking.

~~**COURSE OUTLINE**~~

1. ~~MAJOR GOALS~~

~~1.1 To develop the ability to reason logically and think symbolically 1.2 To develop skills for communicating mathematically 1.3 To build algebraic models, formulate and solve problems 1.4 To improve the skills necessary to be successful in multiple careers~~

~~2. PERFORMANCE OBJECTIVES~~

~~(numbers in parentheses refers to an appropriate California State Standard) 2.1 Algebra II 2.1.1 Solve equations and inequalities involving absolute value. (1.0) 2.1.2 Solve systems of linear equations and inequalities (in two or three variables) by substitution, with graphs, or with matrices. (2.0) 2.1.3 Operations on polynomials, including long division. (3.0) 2.1.4 Factor polynomials representing the difference of squares, perfect square trinomials, and the sum and difference of two cubes. (4.0) 2.1.5 Demonstrate knowledge of how real and complex numbers are related both arithmetically and graphically. In particular, they can plot complex numbers as points in the plane. (5.0) 2.1.6 Add, subtract, multiply, and divide complex numbers. (6.0) 2.1.7 Add, subtract, multiply, divide, reduce, and evaluate rational expressions with monomial and polynomial denominators and simplify complicated rational expressions, including those with negative exponents in the denominator. (7.0) 2.1.8 Solve and graph quadratic equations by factoring, completing the square, or using the quadratic formula. Application of these techniques in solving word problems. Solving quadratic equations in the complex number system. (8.0) 2.1.9 Demonstrate and explain the effect that changing a coefficient has on the graph of quadratic functions; that is determination of how the graph of a parabola changes as a, b, and c vary in the equation y = a(x-b)2 . (9.0) 2.1.10 Graphing quadratics functions and determines the maxima, minima, and zeros of the function. (10.0) 2.1.11 Prove simple laws of logarithms. (11.0) 2.1.12 Understanding of the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents. (11.1) 2.1.13 Judge the validity of an argument according to whether the properties of real numbers, exponents, and logarithms have been applied correctly at each step. (11.2) 2.1.14 Knowledge of the laws of fractional exponents, exponential functions, and the use of these functions in problems involving exponential growth and decay. (12.0) 2.1.15 Use the definition of logarithms to translate between logarithms in any base. (13.0) 2.1.16 Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values. (14.0) 2.1.17 Determine whether a specific algebraic statement involving rational expressions, radical expressions, or logarithmic or exponential functions is sometimes true, always true, or never true. (15.0) 2.1.18 Demonstration and explanation of how the geometry of the graph of a conic section (e.g., asymptotes, foci, eccentricity) depends on the coefficients of the quadratic equation representing it. (16.0) 2.1.19 Given a quadratic equation of the form $ax^2 + by^2 + cx + dy + e = 0$, demonstration of knowledge of the method of completing the square in order to put the~~

~~equation into standard form and recognition of whether the graph of the equation is a circle, ellipse, parabola, or hyperbola. Graphing of the equation. (17.0) 2.1.20 Demonstration of fundamental counting principles to compute combinations and permutations. (18.0) 2.1.21 Demonstration of computing probabilities by using combinations and permutations. (19.0) 2.1.22 Knowledge of the binomial theorem and usage of it to expand binomial expression that is raised to positive integer powers. (20.0) 2.1.23 Application of the method of mathematical induction to probe general statements about the positive integers. (21.0) 2.1.24 Finding the general term and the sums of arithmetic series and of both finite and infinite geometric series. (22.0) 2.1.25 Derivation of the summation formulas for arithmetic series and for both finite and infinite geometric series. (23.0) 2.1.26 Solve problems involving functional concepts, such as composition, defining the inverse function and performing arithmetic operations on functions. (24.0) 2.1.27 Use of properties from number systems to justify steps in combining and simplifying functions. (25.0)~~

~~**3. CONTENT COMPONENTS**~~

~~**(numbers in parentheses refer to appropriate performance objectives) 3.1 Algebra II 3.1.1 Equations or inequalities and systems of equations or inequalities including career applications (2.1.1, 2.1.2) 3.1.2 Polynomials, complex numbers, and rational expressions (2.1.3- 2.1.8, 2.1.17) 3.1.3 Quadratic formula, completing the square and quadratic functions (2.1.8-2.1.10, 2.1.18, 2.1.19) 3.1.4 Logarithms with career applications (2.1.11-2.1.13, 2.1.15-2.1.16, 2.1.17) 3.1.5 Fractional exponents (2.1.14) 3.1.6 Conic Sections (2.1.16) 3.1.7 Combinations and permutations (2.1.20-2.1.21) 3.1.8 Binomial theorem (2.1.22) 3.1.9 Mathematical induction (2.1.23) 3.1.10 Algebraic and geometric series (2.1.24-2.1.25) 3.1.11 Functions (2.1.26-2.1.27)~~**

COURSE CONTENT:

Unit 1: Linear Functions

This unit presents topics that were studied in Algebra 1. Transformation of linear, quadratic, and absolute value functions are explored. The parent functions are established and then transformed functions are compared to the parent. Rigid transformations include vertical and horizontal translations and reflections. Non-rigid transformations are vertical and horizontal stretches and shrinks. Students will review modeling with linear functions which involves writing linear functions from given information and fitting a line to data. Students will solve linear systems, building upon skills from Algebra I to solve systems with three variables.

At the end of the unit, students create equations in two variables to represent the relationship between quantities and graph the equations on coordinate axes and solve a system of linear equations by graphing through a performance task: Secret of the Hanging Baskets.

Unit 2: Quadratic Functions

There are two common forms in which quadratics are written, and each gives information about the graph and the behavior of the function. Understanding the connection between the characteristics of a quadratic and it's equation can help students apply their knowledge when working with real life applications. Students will explore the vertex of quadratic functions as a means to quickly distinguish the type of transformations displayed in a graph. Additionally students will look at characteristics of quadratic functions and their graphs including: lines of symmetry, maximum and minimum points.

Students will examine models using quadratic functions and use https://www.desmos.com/calculator or a graphing calculator to perform regression analysis.

Unit 3: Quadratic Equations and Complex Numbers

Students will use five strategies for solving quadratic functions: graphing, square rooting, factoring, completing the square, and the Quadratic Formula. This unit will require students to make informed decisions as to which strategy is the most efficient. Students will define complex numbers and their operations so that they may move into solving quadratics with imaginary solutions. Finally the students will solve non-linear systems and graph systems of nonlinear inequalities and they will compare solving nonlinear systems graphically and analytically.

At the end of the unit, students will work on creating equations in two variables to represent relationships between quantities. They will find an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression and recognize and explain the concepts to create a model through Algebra in Genetics: The Hardy-Weinberg Law performance task.

Unit 4: Polynomial Functions

Polynomial functions are studied in detail here. Functions will be defined, graphed, and end behavior discussed. Synthetic division and the application of the Remainder Theorem is used to find rational roots. The Fundamental Theorem of Algebra and its corollary are also covered. Graphs of polynomials and their transformations will be explored using technology. Students will use graphs and equations to determine discontinuities, find roots using division, use graphs and equations to model real-life data.

At the end of the unit, students will be given a third-or fourth-degree polynomial function to graph and will be asked to identify actual zeros and non-rational zeros with the graphing calculator and/or synthetic substitution. The end behavior is described and the final graph validated using substitution and comparing the results to the graph.

Unit 5: Rational Exponents and Radical Functions

This unit introduces radicals and *nth* roots, and rational exponents. These concepts are connected to the rules of exponents from Algebra 1 noting the exponents are no longer restricted to natural numbers. The graphs of radical functions are used as a tool to help students think about solutions of radical equations and inequalities. Students will perform operations on rational expressions and solve rational equations and identify extraneous solutions. Students will find critical features of a rational function by finding critical features and apply knowledge of rational functions to solve an application problem.

At the end of the unit, students will be given 3 rational functions. One with a single vertical asymptote and a horizontal asymptote, one with two vertical asymptotes and an oblique asymptote and the third with a hole, a vertical asymptote and a horizontal asymptote. Students can be put into groups and go through the process of identifying all critical components and graphing all three functions. Similarities and differences of each function will also need to be discussed and shared out to the class.

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Unit 6: Exponential and Logarithmic Functions
This unit presents exponential and logarithmic functions. Students will write and graph logarithmic functions using the common base 10, *e,* and other bases. These types of functions will be applied to real-life applications. Students will progress to solving exponential and logarithmic equations using different approaches: analytical, and graphical. Students will work with a real data set and model it using logarithmic or exponential functions.

At the end of the unit, students will be working in small groups and will be given a function modeling exponential decay of radioactive substances to interpret the constants in the equation, then evaluate the function at different times. Students will graph the function and discuss important features of the graph, such as the y-intercept and the horizontal asymptote making sure to explain what each represents.

Unit 7: Rational Functions
Rational functions are explored in this unit. The unit uses the simplest rational function, inverse variation, to introduce the concept. Graphs of rational functions will be used to identify horizontal and vertical asymptotes. Students will learn about inverse variations and combined variations. Students will extend this experience to identifying these asymptotes from the actual rational expression without looking at the graphs.

At the end of the unit, students will work together on a performance task: Circuit Design, using rational expressions to solve electrical engineering problems.

Unit 8: Sequences and Series
This unit will extend the students' knowledge and use of arithmetic and geometric sequences. The students will explore sums and partial sums of infinite geometric series both numerically and graphically. The students will also explore recursive sequences as well with connections to linear and exponential functions.

At the end of the unit, students will need to write a rule for a sequence that represents the number of transitions that could fit on a 1-inch diameter circuit and use the rule to predict how many transistors will be able to fit on a circuit.

Unit 9: Trigonometric Ratios and Functions
This unit takes our study of functions to the trigonometric functions and as such begins with a review of the trigonometric ratios and right triangle geometry. Students will use radians and the six trigonometric functions defined by the unit circle. Graphs of sine and cosine are developed by plotting functional values for benchmark angles and the concept of periodic functions is introduced. The graphs of the remaining four trigonometric functions are deduced from knowing the relationships between these functions and sine and cosine. Knowledge of transformations is used to plot functions. The students will also be introduced to the trigonometric identities and the sum and difference formulas. Students will use their knowledge to use and manipulate the formula for work which relies on trigonometry as it is applied to different real-life applications.

At the end of the unit, students will work on a performance task: Lightening the Load to determine the easiest way to move a heavy table across the room; should you push it; should you tie a rope around one leg of the table and pull it using trigonometry to make the right decision.

Unit 10: Probability

This unit starts with the classical concept of sample space and probability. As students develop their skills they will calculate the probability of independent and dependent events and use two-way tables to calculate marginal frequencies. Permutations and combinations will be used to calculate the probabilities of compound events and to solve real-life problems. The students will explore the binomial and normal distributions as well.

At the end of the unit, students can work in small groups to develop a game and determine the probability of the events in the game.

Unit 11: Data Analysis and Statistics

Data collection and analysis will be explored in this unit. The normal distributions will be used to calculate *z* scores and find the associated probabilities of events from the normal table. The concepts of experimental design to avoid bias will be covered. Students will understand the difference between an observational study and experiment and that correlation does not determine causality. Students will use data to make inferences about a population. The objective of this unit is that all students will become more analytic as they read or hear accounts of research or statistical claims asserted by organizations.

At the end of the unit, students will analyze the validity of curving test scores based on the assumption that their scores are from normal distribution and defend their position.

4. TIME ESTIMATES

Instructional sequences vary in length from a few days to several weeks

~~**5. INSTRUCTIONAL MATERIALS**~~

~~5.1 District adopted textbooks 5.2 Supplementary and teacher-created materials that include a career focus 5.3 Technology materials~~

COURSE MATERIALS

Authors	Copyright	Publisher	Title	Website
Larson, R. & Boswell	2019	National Geographic Learning	Big Ideas Math: Algebra 2	www.bigideaslearning.com

Teacher support resources can also be found in the Educational Services Website and supplemental online curriculum (for ex. Apex).

~~6.~~ EVALUATION OF STUDENT PROGRESS:

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~~Student communicates mathematically and demonstrates content knowledge in a variety of ways that lead to mathematical competence in their chosen careers. 6.1 Teacher observation 6.2 Written assignments and projects 6.3 Quizzes and tests 6.4 Rubrics~~

Assessment Methods:

- Summative assessment
- Formative Assessment

Formative:

- Mathematical Discourse
- Reflection questions
- Teacher observations/evidence
- Student discussions
- Quiz
- Exit ticket

Summative:

- Performance task
- Unit Assessment

Committee Members:

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