ACALANES UNION HIGH SCHOOL DISTRICT
COURSE OF STUDY: CURRICULAR AREA – MATH

COURSE TITLE:	ALGEBRA B
GRADE LEVEL:	10-12
COURSE LENGTH:	One Year
PREFERRED PREVIOUS COURSE OF STUDY:	Algebra A
CREDIT:	10 Credits
UC/CSU CREDIT:	Meets UC/CSU credit for mathematics requirement; subject area (“c”)
GRADUATION REQUIREMENT:	Fulfills 10 units of Algebra 1 credit required for graduation
STANDARDS AND BENCHMARKS:	California Common Core State Standards in Mathematics
ADOPTED:	May 20, 2015
INSTRUCTIONAL MATERIALS:	Big Ideas Algebra 1, Big Ideas Learning, 2015

COURSE DESCRIPTION: Algebra B formalizes and extends the mathematics that students learned in Common Core math 6 – 8. This course includes content standards from the conceptual categories of Number and Quantity, Algebra, Functions, and Statistics and Probability. Through the application of the Standards for Mathematical Practice, students will increasingly engage with the subject matter and grow in mathematical maturity and expertise.

COURSE OBJECTIVES:

Content Objectives

During the course students will:

1. Develop and extend an understanding of linear and exponential relationships including contrasting these models
2. Solve linear and quadratic equations
3. Engage in methods for analyzing quadratic functions
4. Explore, manipulate, and compare different types of function
5. Analyze real world data using statistics

Skill Objectives:

During the course students will work toward:

1. Active learning through investigation and conjecture
2. Consistent study habits, organization, and personal responsibility for learning
3. Proficiency in writing about mathematics and fluency in using mathematical vocabulary
4. Strategic implementation of instructional technologies
5. Effective communication and collaboration

ASSESSMENT: Assessments are designed to promote and evaluate mathematical thinking. Teachers use engaging activities that involve students in investigating, conjecturing, verifying, applying, evaluating, and communicating in various assessment modalities.

Formal and informal assessments can be made on the basis of both individual and group work. Assessments should be from a variety of means and could include performance tasks, quizzes, tests, projects, investigations, and daily assignments.

Assessments should be measuring the following claims:
Claim #1 – Concepts & Procedures
Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.
Claim #2 – Problem Solving
Students can solve a range of complex well-posed problems in pure and applied mathematics, making productive use of knowledge and problem solving strategies.
Claim #3 – Communicating Reasoning
Students can clearly and precisely construct viable arguments to support their own reasoning and to critique the reasoning of others.
Claim #4 – Modeling and Data Analysis
Students can analyze complex, real-world scenarios and can construct and use mathematical models to interpret and solve problems.

Performance Tasks
Performance tasks are used to better measure capacities such as depth of understanding, research skills, and complex analysis, which cannot be adequately assessed with selected- or constructed-response items. These tasks may require students to evaluate, optimize, design, plan, model, transform, generalize, justify, interpret, represent, estimate, and calculate solutions. Performance Tasks can be used for a variety of purposes such as topic engagement, formative and evaluative assessment. They may be performed individually or in small groups, depending on the purpose of assessment.

Performance tasks should:

- Integrate knowledge and skills across multiple claims
- Require student-initiated planning and management of information and ideas
- Reflect a real-world task and/or scenario-based problem
- Allow for multiple approaches
- Represent content that is relevant and meaningful to students
- Be assessed using an understandable rubric that provides meaningful feedback for students and the teacher

GRADING GUIDELINES: See AUHSD Grading Guidelines: Final Mark Rubric and Final Course mark Determination Components

COURSE CONTENT:

Mathematical Practices

The Standards for Mathematical Practice are “habits of the mind of mathematically proficient students”. They describe the attributes that mathematics educators at all levels are striving to develop in their students, as these practices are based on key mathematical processes and proficiencies. The goal of implementing these practices is to develop students who can use their knowledge of mathematics in flexible, sophisticated, and relevant ways across multiple disciplines.

#1 Make sense of problems and persevere in solving them (Hypothesize & Strategize)

- Students are:
  - Making conjectures about what the problem is asking and how they can begin to solve it
  - Checking for the reasonableness of the strategy as the work progresses and making adjustments as needed
- Teachers develop this skill by having students:
  - Explain the meaning of the problem and/or restate the problem
  - Analyze the given information and develop entry points into the problem and develop strategies for solving the problem
  - Execute and evaluate multiple strategies

#2 Reason abstractly and quantitatively (De/Contextualize)

- Students are:
  - Determining what numbers and symbols represent through the use of diagrams, graphs or equations
- Teachers develop this skill by having students:
  - Move between multiple representations to determine the meaning behind quantities
  - Express purely mathematical expressions with real world context and taking quantities out of context and representing them as abstract mathematical ideas or expressions

#3 Construct viable arguments; critique others’ reasoning

- Students are:
  - Justifying their thinking by providing evidence based on mathematical properties and using that evidence to evaluate the reasoning of others
- Teachers develop this skill by having students:

- Make conjectures, compare and contrast methods, and identify flawed logic by providing counter-example

#4 Model with Mathematics

- Students are:
  - Interpreting and constructing graphs, tables, number lines, diagrams or equations to model real-world situational data
- Teachers develop this skill by having students:
  - Use models to make interpolative and extrapolative inferences
  - Examine the effectiveness and appropriateness of a model

#5 Use appropriate tools strategically

- Students are:
  - Selecting appropriate math tools and technology to help solve problems including manipulatives, graphing utilities, tables, matrices, computer applications, compasses, etc.
- Teachers develop this skill by having students:
  - Identify the strengths and weaknesses of different tools in relation to solving a given problem and also use tools to explore, confirm or deepen understanding

#6 Attend to Precision

- Students are:
  - Calculating quantities accurately through proper rounding (based on context), labeling of units of measure, and checking their work
  - Selecting a problem solving method that allows for appropriate precision
- Teachers develop this skill by having students:
  - Formulate precise explanations of their work using vocabulary and justify their rounding process
  - Re-examine their work or thinking process, and then demonstrate the method by which they check their answers

#7 Look For and Make Use of Structure

- Students are:
  - Looking for patterns or relationships and using that structure to simplify complex ideas
- Teachers develop this skill by having students:

- Extend prior knowledge of similar situations to novel ones or break down complex problems in smaller parts which resemble simpler, more familiar ideas

#8 Look for and express regularity in repeated reasoning (Generalize)

- Students are:
  - Developing general methods, rules, or short cuts and determining when they are appropriate
- Teachers develop this skill by:
  - Facilitating activities which allow for students' "aha!" moments and then helping them use it to develop "rules" based on repeated trials with a process

Quadratic/Exponential Functions (B)	
Common Core State Standard (CCSS)	**Learning Objective**
8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g.,π^2). For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	• Estimating irrational numbers in preparation for graphing solutions of a quadratic
8.EE.2 Use square root and cube root symbols to represent solutions to equations of the form x^2 = p and x^3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.	• Simplify square roots in preparation for solving quadratic equations
F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.	• Use and interpret function notation with quadratic and exponential functions • Graph, evaluate and interpret quadratic and exponential functions • Identify the graphical characteristics of quadratic functions: shape of graph, vertex, axis of symmetry, maximum or minimum and possible intercepts • Identify the graphical characteristics of exponential functions: shape of graph, possible intercepts, the asymptote and end behavior • Differentiate between exponential growth and decay by inspection of equations and graphs • Use graphs to solve quadratics by identifying the x-intercepts as the zeros • Graph quadratics using the axis of symmetry equation x=-b/(2a)
F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.	• Identify the domain of quadratic and exponential functions from function notation and graphs • Model a real world scenario by writing, evaluating and/or graphing a function • Consider the context of the problem when verifying solutions (constraints)

8.F.3 Interpret the equation y = mx + b as defining a linear function, whose graph is a straight line; give examples of functions that are not linear. For example, the function A = s^2 giving the area of a square as a function of its side length is not linear because its graph contains the points (1,1), (2,4) and (3,9), which are not on a straight line.	• Review of linear equations in preparation for analyzing different types of functions (linear, quadratic, exponential)
F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	• Differentiate between types of functions (linear, quadratic, exponential) by analyzing the rate of change between a set of ordered pairs given a table, list or graph
8.F.5 Describe qualitatively the functional relationship between two quantities by analyzing a graph (e.g., where the function is increasing or decreasing, linear or nonlinear). Sketch a graph that exhibits the qualitative features of a function that has been described verbally.	• Review of linear equations in preparation for analyzing different types of functions (linear, quadratic, exponential)
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	• Given the general equation of a quadratic or exponential function, understand how the parameters of the equation affect the graph (e.g. how the "a" value of a quadratic changes the direction of the opening or how the "b" value of an exponential function determines growth or decay)
F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.	• Graph quadratic functions and show intercepts, maxima, and minima. • Graph exponential functions, showing intercepts and end behavior.

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. b. Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)t, y = (0.97)t, y = (1.01)12t, y = (1.2)t/10, and classify them as representing exponential growth or decay.	• Rewrite quadratic functions between the different forms: standard, vertex and intercept (factored) form • Rewrite an exponential functions with negative exponents as exponential functions with fractional bases (e.g. 2^(-x)=(1/2)^x) • Use the process of factoring and completing the square in a quadratic function to show zeros, vertex, and symmetry of the graph, and interpret these in terms of a context • Use the properties of exponents to interpret expressions for exponential functions. (e.g. Identify percent rate of change in functions and classify them as representing exponential growth or decay)
F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.	• Given two different representations, compare key characteristics of alike functions. (e.g. minimum/maximum for quadratics or growth rate for exponential)
F.BF.1 Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.	• Create a quadratic or exponential function to model data or a real world scenario
F.BF.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.	• Graph a function using transformations of a parent function: quadratic or exponential • Analyze the transformations of a parent function on a graph and write the indicated function

Quadratic Equations	
Common Core State Standard (CCSS)	**Learning Objective**
8.NS.1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.	• Categorize numbers as rational or irrational in preparation for graphing and solving quadratic equations
8.NS.2 Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g.,π^2). For example, by truncating the decimal expansion of √2, show that √2 is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.	• Categorize numbers as rational or irrational in preparation for graphing and solving quadratic equations
N.RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.	• Simplify radical expressions with a non-negative radicands
N.CN.7 Solve quadratic equations with real coefficients that have imaginary solutions. Ex: x^2 = -4	• Define *i* • Simplify radical expressions with a negative radicand • Solve simple quadratic equations with pure imaginary solutions.
A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.	• Factor polynomials including special cases • Find the zeros of a quadratic function using graphing, the Zero Product Property and/or factoring • Use intercepts and points to graph and write quadratic functions • Use completing the square to solve quadratic equations, find and use maximum/minimum values • Use appropriate techniques to solve real world scenarios

A.REI.4 Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form (x – p)2 = q that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for x2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b.	• Use completing the square to solve quadratic equations (square root property) • Observe and understand the derivation of the quadratic formula • Use the quadratic formula to solve quadratic equations • Interpret the value of the discriminant to determine the nature of the roots • Determine and apply the appropriate strategy to factor the given polynomial
A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = –3x and the circle x2 + y2 = 3.	• Solve systems of non-linear equations algebraically and by graphing (e.g. a line and a parabola, two parabolas, etc.)