04 Quadratic Functions and Complex Numbers

Content Area: **TEMPLATE**
Course(s):
Time Period: **Full Year**
Length: **2 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This course is an extension of Algebra 1. Emphasis is upon the development of insights into the structure of algebra as a deductive process. The content includes function foundations, equations and inequalities, polynomial functions and equations, rational functions and equations, radical expressions and equations, exponential and logarithmic functions and equations, trigonometric functions and equations, introductory data analysis, and probability.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives:

- Solutions exist that are not within the set of the real numbers.
- All number systems are subsets of the complex number system.

Essential Questions:

- What are the advantages of a quadratic function in vertex form? In standard form?
- How is any quadratic function related to the parent quadratic?
- How are the real solutions of a quadratic equation related to the graph of the related quadratic?
- How do quadratic equations model real world problems and situations?
- Why are complex number necessary?
- How are operations and properties of complex numbers relate to those of real numbers?

Enduring Understanding:

- A basis for the complex numbers is a number whose square is -1.
- Every quadratic equation has complex number solutions.
- A number system is a way of organizing numbers to accurately and consistently represent quantities and relationships
- Properties of the real number system apply to complex numbers.

CONTENT AREA STANDARDS

HS Functions

F.BF

A. Build a function that models a relationship between two quantities

B. Build new functions from existing functions

F.IF

A. Understand the concept of a function and use function notation

B. Interpret functions that arise in applications in terms of the context

C. Analyze functions using different representations

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.
MA.N-CN.A.1	Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
MA.N-CN.A.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
MA.N-CN.B.4	Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.
MA.N-CN.C.7	Solve quadratic equations with real coefficients that have complex solutions.
MA.N-CN.C.8	Extend polynomial identities to the complex numbers.
MA.A-REI.B.4b	Solve quadratic equations by inspection (e.g., for $x^2 = 49$), 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 $a \pm bi$ for real numbers a and b.

RELATED STANDARDS (Technology, 21st Century Life & Careers, ELA Companion Standards are Required)

LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
CS.K-12.3.a	Identify complex, interdisciplinary, real-world problems that can be solved computationally.
CS.K-12.3.b	Decompose complex real-world problems into manageable sub-problems that could

	integrate existing solutions or procedures.
CS.K-12.3.c	Evaluate whether it is appropriate and feasible to solve a problem computationally.
CS.K-12.4.a	Extract common features from a set of interrelated processes or complex phenomena.
CS.K-12.4.d	Model phenomena and processes and simulate systems to understand and evaluate potential outcomes.

STUDENT LEARNING TARGETS

Refer to the 'Declarative Knowledge' and 'Procedural Knowledge sections.

Declarative Knowledge

Students will understand that:

- Solution exist that are not within the set of the real numbers
- All number systems are subsets of the complex number system
- Complex numbers can be represented graphically on the complex plane
- Powers of the complex number, *I*, can be written in the form of using the definition $i^2 = -1$
- The product of a conjugate of a complex number and itself will always be a real number; the conjugate can be used to simplify expressions and equations containing complex numbers
- Operations can be performed within the set of complex numbers written in standard form
- Every complex number has the form $a + bi$ with a and b real
- Complex numbers are made up of real and imaginary numbers

Procedural Knowledge

Students will be able to:

- Preform arithmetic operations with complex numbers
- Transform a complex number into its standard form, $a + bi$
- Represent complex numbers and their operations on the complex plain
- Using complex numbers in polynomial identities and equations
- Solve linear and non-linear equations with/without complex solutions
- Cite phenomena that have context in the complex number system
- Explain why the rectangular and polar forms of a given complex number represent the same number
- Represent complex numbers on the complex plane in rectangular and polar form

- Use the quadratic formula to give complex solutions
- Use the combative, associative, and distributive properties to add, subtract, and multiply complex numbers
- Solve quadratic equations with real coefficients that have complex solutions

EVIDENCE OF LEARNING

Refer to the 'Formative Assessments' and 'Summative Assessments' sections.

Alternate Assessments

- Portfolios
- Verbal Assessment (instead of written)
- Multiple choice
- Modified Rubrics
- Performance Based Assessments

Benchmark Assessments

Benchmark Assessments conducted three times per year, using Pear Assessment (Standards Based Assessments)

Formative Assessments

- Class Discussion
- Teacher observation
- Exit/Entrance Tickets
- Classwork
- Homework

Summative Assessments

- Quizzes
- Test
- Projects

RESOURCES (Instructional, Supplemental, Intervention Materials)

Core Instructional Materials

- Sullivan Algebra and Trigonometry Textbook (chapter 4)

Supplemental Materials

- Khan Academy
- Online Tutorials for Complex Numbers
  - http://www.clarku.edu/~djoyce/complex/
  - http://tutorial.math.lamar.edu/Classes/Alg/ComplexNumbers.aspx
- Illustrative Math
- Illustrative Mathematics Task by Standard
- Desmos
  - https://teacher.desmos.com/activitybuilder/custom/56094c8558e4a93806b14a58
  - https://teacher.desmos.com/activitybuilder/custom/5e91f68896f3bb0642f35f27?collections=5e80e25ec9089c33af3d954f
- Deltamath
- Complex Number Video

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations such as trajectory, maximizing area, crime scene analysis, and stock analysis. Examples can be found in topic specific textbook problems and digital resources.

ACCOMMODATIONS & MODIFICATIONS FOR SUBGROUPS

See link to Accommodations & Modifications document in course folder.