05 Polynomial Functions and Equations

Content Area: **Math**
Course(s):
Time Period: **Full Year**
Length: **6 weeks**
Status: **Published**

General Overview, Course Description or Course Philosophy

This unit will focus on strengthening the prerequisite skills and conceptual understanding needed to graph polynomial functions and identify key components of a polynomial function. Lesson activities will reinforce new content and address common misconceptions and errors to support students' progress toward analyzing polynomial functions.

OBJECTIVES, ESSENTIAL QUESTIONS, ENDURING UNDERSTANDINGS

Objectives/Enduring Understandings:

- Polynomial functions are smooth and continuous.
- Polynomial functions can be used to model complex scenarios and relationships between a domain and a range.
- Analyzing the graph of a polynomial function provides information about the properties of the function.

Essential Questions:

- What is the significance of the zeros of a polynomial function?

STUDENT LEARNING TARGETS

Declarative Knowledge

Students will understand that:

- Characteristics of quadratic functions such as x intercepts and end behavior are only portion of the unit of this study of polynomials and more complex polynomials also have general characteristics.
- Characteristics of a polynomial function apply to the visual behavior of the function.
- Long and synthetic division are methods used to determine the relationship between and the zeros and the factors of a polynomial function.
- A graph is an effective ways to determine the solutions of a polynomial function.
- The Remainder Theorem determines whether (x - a) is a divisor of a polynomial
- It is possible to evaluate key features such as y intercept, zeros and nature of roots algebraically.
- Descarte's Rule of Signs determines the maximum number of positive and negative real roots of a polynomial.
- Complex roots always occur in pairs
- The Fundamental Theorem of Algebra determines the number of roots of a polynomial, both real and complex.

Procedural Knowledge

Students will be able to:

- Determine key features of polynomials algebraically (y intercept, zeros, nature of roots)
- Perform polynomial operations
- Explain how to determine if complex roots exist by expecting a graph and its equation.
- Utilize technology to approximate real roots.
- Explain the relationship between zeros/potential zeros and factors of the polynomial.
- Use Synthetic, Long division or the reverse box method to divide polynomials.
- Factor polynomials algebraically over real and complex numbers
- Identify , evaluate and graph polynomial functions
- Extend polynomial identities to complex numbers (for example, $x^2 + 4$ as (x - 2i)(x + 2i)

CONTENT AREA STANDARDS

MA.F-BF.A.2	Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
MA.F-BF.B.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $kf(x)$, $f(kx)$, 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.
MA.F-IF.B.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.
MA.F-IF.B.5	Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

MA.F-IF.B.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.
MA.F-IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
MA.F-IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
MA.F-IF.C.8a	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.
MA.A-APR.A.1	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
MA.A-APR.B.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
MA.A-APR.B.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
MA.A-APR.C.4	Prove polynomial identities and use them to describe numerical relationships.
MA.A-REI.D.10	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).
MA.A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context.
MA.A-SSE.A.2	Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.
MA.A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
MA.A-SSE.A.1b	Interpret complicated expressions by viewing one or more of their parts as a single entity.

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

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.
LA.K-12.NJSLSA.R7	Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
TECH.9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8).
TECH.9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
TECH.K-12.P.5	Utilize critical thinking to make sense of problems and persevere in solving them.
TECH.K-12.P.8	Use technology to enhance productivity increase collaboration and communicate effectively.

EVIDENCE OF LEARNING

Formative Assessments

- Student feedback/questioning/observation
- Error analysis
- Specific skill assessment/questions
- Survey/polling
- Task completion and review of quizzes and material presented in the Algebra II class

Summative Assessments

There will be no formal assessments in this course.

RESOURCES (Instructional, Supplemental, Intervention Materials)

Desmos Activities: Polynomial Division The Remainder Theorem, How can I solve it? (Reverse Box Method Technique), Sketching Polynomials without Desmos, Polynomial Operations Practice , Zeros of Polynomial Functions, Zeros of a function Marble Slide,
Kuta Software worksheets

Approved course textbook

INTERDISCIPLINARY CONNECTIONS

Interdisciplinary connections are frequently addressed through modeling and application problems whereby students solve and analyze situations taken from business, physics, engineering, biology, statistics, geography, and numerous other fields. 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.