

Advanced Topics in Mathematics introduces students to advanced functions, with a focus on developing a strong conceptual grasp of the expressions that define them. Additionally, students will be exposed to topics necessary for advanced mathematics such as conic sections, complex numbers, trigonometry, and probability. Throughout the course, students will learn through discovery and application, developing the skills they need to break down complex challenges and demonstrate their knowledge in new situations.

Course topics include quadratic functions; transformations of functions, polynomial functions; rational expressions and equations; exponential and logarithmic functions; right triangle trigonometry, trigonometric functions, perimeter and volume, polar coordinates, complex number arithmetic as well as probability and probability distributions.

This course supports all students as they develop computational fluency and deepen conceptual understanding. Students begin each lesson by discovering new concepts through guided instruction, and then confirm their understanding in an interactive, feedback-rich environment. Modeling activities equip students with tools for analyzing a variety of real-world scenarios and mathematical ideas. Journaling activities allow students to reason abstractly and quantitatively, construct arguments, critique reasoning, and communicate precisely. Performance tasks prepare students to synthesize their knowledge in novel, real-world scenarios and require that they make sense of multifaceted problems and persevere in solving them.

This course is built to Florida's Next Generation Sunshine State Standards and Benchmarks.

Length: Two Semesters

### Unit 1: Quadratic Functions

- Factoring  $x^2 + bx + c$
- Factoring  $ax^2 + bx + c$
- Special Cases
- Solving Quadratic Equations
- Completing the Square
- The Quadratic Formula
- Graphs of Quadratic Functions
- Imaginary Numbers
- Review of Complex Numbers
- Performance Task: The Skid Distance Problem
- Quadratic Functions Wrap-Up

### Unit 2: Transforming Functions

- Inverses

- Graphs of Inverses
- Parent Functions
- Shifting Functions
- Stretching Functions Vertically
- Transformation of Parent Functions
- Arithmetic of Functions
- Performance Task: Transforming Functions
- Transforming Functions Wrap-Up

### **Unit 3: Polynomial Functions**

- Polynomial Basics
- Polynomial Functions
- Factoring Polynomials Completely
- Solving Polynomial Equations
- Graphing Polynomial Functions
- Polynomial Identities
- Binomial Theorem
- Transformations of Polynomial Functions
- Polynomial Functions Wrap-Up

### **Unit 4: Rational Expressions and Functions**

- Inverse Variation
- Solving Rational Functions
- Vertical Asymptotes
- Graphing Rational Functions
- Rational Expressions and Functions Wrap-Up

### **Unit 5: Exponential and Logarithmic Functions**

- Geometric Sequences
- Exponential Functions
- Examples and Applications of Exponential Functions
- Graphs of Exponential Functions
- Logarithmic Functions
- Graphs of Logarithmic Functions
- Properties of Exponents and Logarithms
- Solving Exponential Equations
- Solving Logarithmic Equations
- Applications of Logarithms
- Comparing and Analyzing Function Types
- Exponential and Logarithmic Functions Wrap-Up

### **Unit 6: Semester 1 Exam**

### **Unit 7: Trigonometry**

- Trigonometric Ratios and the Unit Circle
- Graphs of Sine and Cosine

- Graphs of Other Functions
- Simple Transformations of Sinusoids
- General Transformations of Periodic Graphs
- Inverse Trigonometric Functions
- Identities and Proof
- Trigonometric Identities
- Trigonometry Wrap-Up

### **Unit 8: Perimeter, Area, and Volume**

- Circumference and Arc Length
- Area and Sectors
- What Is a Polyhedron?
- Volume
- Spheres
- Circles Without Coordinates Wrap-Up

### **Unit 9: Conic Sections**

- Introduction to Conic Sections
- Ellipses
- Hyperbolas
- Parabolas
- Conic Sections Wrap-Up

### **Unit 10: Complex Numbers**

- Polar Coordinates
- Graphs of Polar Functions
- Polar Form of Complex Numbers
- Arithmetic of Complex Numbers
- Powers and Roots of Complex Numbers
- Complex Numbers Wrap-Up

### **Unit 11: Applications of Probability**

- What Is Probability?
- Counting Principles
- Permutations and Combinations
- Basic Rules of Probability
- Conditional Probability
- Independence
- Bayes's Theorem
- Simulations
- Applications of Probability Wrap-Up

### **Unit 12: Probability Distributions**

- Discrete Random Variables
- Continuous Random Variables

- Binomial Probability Distributions
- Probability Distributions Wrap-Up

**Unit 13: Semester 2 Exam**

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