

Southern Connecticut State University
MAT 405
Elementary Mathematics from an Advanced Standpoint

- I. **Catalog Description:** An examination of the theoretical basis for fundamental topics which are normally taught in secondary schools.

- II. **Purpose:**
MAT 405 serves as preparation for students going out to student-teach. Students will take a deeper look at foundational concepts that are taught in the secondary school mathematics curriculum. Students become familiar with the National Council of Teachers of Mathematics (NCTM) and Common Core State Standards, and how they apply to the mathematics they will teach in the secondary school. Students form a conceptual base of understanding from which lessons can be planned. In addition to content areas, students will also experiment with Desmos and GeoGebra.

- III. **Credit**
MAT 405 carries three semester-hours of university credit.

- IV. **Prerequisite:**
'C-' or better in MAT 250, junior status and mathematics major.

- V. **Format**
MAT 405 is offered in the lecture-discussion format .

- VI. **Course Objectives:** By the end of this course, a successful student should be able to do the following:
 - A. Explain and establish connections between multiple forms of the concept of function.
 - B. Describe the transformation of a function based on its equation.
 - C. Develop a mathematical model of quadratic, exponential, logarithmic, and trigonometric functions based on the scatter plot of original data.
 - D. Provide the recursive and explicit forms of the n th term of a sequence.
 - E. Understand the real number system and motivate the definitions of integral, rational, and irrational exponents.
 - F. Analyze and correct geometric definitions and proofs for errors.
 - G. Apply recursive formulas involving geometric patterns and number patterns.
 - H. Use technology appropriately to create models of functions and investigate mathematical concepts.
 - I. Respond to classroom situations that require teachers to remediate student's misconceptions.

VII. Outline

- A. Real number system (13%)
 - 1. Integers
 - 2. Operations on Rational and Irrational Numbers
 - 3. Algebraic and Transcendental Numbers
- B. Functions (15%)
 - 1. Definitions, properties, and representations
 - 2. Transformations
 - 3. Injective and Surjective
 - 4. Inverse Functions
 - 5. Composition of Functions
- C. Recursion (15%)
 - 1. Arithmetic Sequences and Series
 - 2. Geometric Sequences and Series
- D. Exponential and Logarithmic Expressions and Functions (15%)
 - 1. Laws of Exponents and their Proofs
 - 2. Laws of Logarithms and their Proofs
 - 3. Graphing Exponential and Logarithmic Functions (with transformations)
- E. Geometry (15%)
 - 1. Definitions
 - 2. Axiomatic Geometry
 - 3. Transformation Geometry
 - 4. Coordinate Geometry
- F. Trigonometry (15%)
 - 1. Definitions
 - 2. Graphs of Trigonometric Functions
 - 3. Inverse Trigonometric Functions
 - 4. Trigonometric Identities and Equations
- G. Complex numbers (12%)
 - 1. Operations
 - 2. Graphing
 - 3. Polar Form
 - 4. DeMoivre's Theorem
 - 5. Roots of unity
 - 6. Euler's Formula and Its Proof Using Taylor Series

VIII. **Assessment:** Individual instructors may vary assessment modes, but typically grades will be based on a combination of

- Homework assignments
- Written exams (midterm and final exams)
- In-class assignments
- 3 – 4 oral exams covering scenarios they may encounter in the classroom in the following content areas:
 - Algebra
 - Geometry
 - Numbers and Operations
 - Problem Solving and Proofs

IX. **Recommended Texts**

1. Usiskin, Peressini, Marchisotto, and Stanley *Mathematics for High School Teachers*, 1st edition, Pearson, 2002.
2. Bremigan, Bremigan, Lorch *Mathematics for Secondary School Teachers*, 1st edition, AMS, 2011.

X. **Waiver Policy:** This course may not be waived.

XI. **Prepared and Approved**

Prepared in March 2023.

Approved by the Mathematics DCC on .

Approved by the Mathematics Department on .

XII. **Preparers**

2023: K. Kruczek and Y. Lee