Math 1145: Development of the Number System

Credit hours: **3 credit hours**
Prerequisites: **MATH 1139 with a grade of C or better**

Course Description

Topics covered in this course include ancient numeration systems; bases; modulo arithmetic; set theoretical and historical development of our number system including natural numbers; integers; rational, irrational, imaginary and complex numbers (with operations and computation within each system); groups and fields; and elementary number theory (basic proofs, divisibility rules, Pythagorean studies, Fermat and Mersenne numbers). Note: Recommended for future teachers.

Course Objectives

1. Provide students with a deeper understanding and appreciation of mathematics
2. Question and investigate our numeration system
3. Establish effective mathematics teaching practices and facilitate meaningful mathematics discourse

Learning Outcomes

1. Understand additive and place-value systems of numerations including Egyptian, Hindu, Arabic, Roman, and Babylonian numerals
2. Convert base 10 numerals to numerals in other bases and convert numerals in other bases to base 10
3. Make calculations in other bases (e.g. addition, subtraction, multiplication and division)
4. Explore the basics of number theory including the properties and conventional operations associated with prime numbers, integers, rational numbers, irrational numbers, real numbers, and complex numbers
5. Utilize the conjugate to rationalize a denominator of an irrational or complex number
6. Identify and set up general arithmetic for geometric sequences
7. Investigate the Fibonacci sequence and it's relationship with the golden ratio
8. Examine mathematical systems with or without numbers and demonstrate whether or not the commutative and associative properties apply
9. Test a mathematical system for closure, an identity element, and inverses
10. Determine whether or not a mathematical system is a group or commutative group
11. Probe modulo systems and modulo classes
12. Perform arithmetic in modulo systems
13. Write basic proofs of the Pythagorean Theorem and the golden proportion
14. Use modulo classes to write basic proofs involving even and odd numbers
15. Study graph theory including the Konigsberg bridge problem

Course Topics

I. PLACE- VALUE NUMERATIONS
   A. Egyptian
   B. Hindu
   C. Arabic
   D. Roman
   E. Babylonian

II. NUMBER THEORY
   A. Prime numbers

B. Integers
C. Rational numbers
D. Irrational numbers
E. Real numbers
F. Complex numbers

III. CONJUGATES
A. Rationalize denominator
1. Irrational numbers
2. Complex numbers

IV. SEQUENCES
A. Arithmetic
B. Geometric
C. Fibonacci

V. PROPERTIES
A. Commutative property
B. Associative property
C. Closure
D. Identity
E. Inverse

VI. MODULAR SYSTEMS
A. Modular arithmetic
B. Modulo classes

VII. PROOFS
A. Pythagorean theorem
B. Golden ratio
C. Odd/Even numbers using modulo classes

VIII. GRAPH THEORY
A. Definitions
B. Examples and non-examples
C. Konigsberg bridge problem