STEPHEN F. AUSTIN STATE UNIVERSITY

**Department of Mathematics and Statistics**

# Math 415–Number Theory
# Course Syllabus

**Course description:** Properties of natural numbers. Unique factorization, residue solution of congruences, arithmetic functions, quadratic reciprocity law, distribution of primes. Diophantine equations, continued fractions, algebraic numbers.

**Credit hours:** 3

**Course Prerequisites and Corequisites:** MTH 311

**Course outline:**

| | Approximate time spent |
|---|---|
| • **Divisibility and the Congruences** | 20% |
| ○ Greatest common divisor | |
| ○ Linear equations and the GCD | |
| ○ Congruences | |
| ○ Euler Phi function | |
| ○ Fermat's Little Theorem | |
| ○ Chinese Remainder Theorem | |
| • **Primes** | 25% |
| ○ Infinitude of primes | |
| ○ Primes in arithmetic progressions | |
| ○ Distribution of primes | |
| ○ Special primes (Mersenne) | |
| ○ Primality testing | |
| ○ Coding | |
| • **Quadratic Reciprocity** | 25% |
| ○ Roots modulo m | |
| ○ Square modulo a prime | |
| • **Diophantine Equations** | 15% |
| ○ Pythagorean triples | |
| ○ Discussion of Fermat's Last Theorem | |
| ○ Square and triangular numbers | |
| ○ Pell's Equation | |
| ○ Normality and factor groups | |
| • **Selected topics** | 15% |
| ○ Gaussian Integers | |
| ○ Unique Factorization | |
| ○ Continued Fractions | |
| ○ Error Bounding | |

**Student Learning Outcomes (SLO):** At the end of MTH 415, a student who has studied and learned the material should be able to:

1. Recognize and be able to prove theorems about congruences, divisibility and primality. [PLO: 1,3,5]
2. Demonstrate understanding of the importance of Fermat's Last Theorem in the development of modern number theory. [PLO 3]
3. Read and understand topics in number theory, and given appropriate definitions and theorems, prove minor theorems. [PLO: 1,2,3]
4. Create examples and counterexamples to test the validity of a number theoretic statement. [PLO: 2,4,5]

**Program learning Outcomes (PLO):**

Students graduating from SFASU with a B.S. degree and a major in mathematics will:

1. Demonstrate comprehension of core mathematical concepts. [***Concepts***]
   (notion of theorem, mathematical proof, logical argument)
2. Execute mathematical procedures accurately, appropriately, and efficiently. [***Skills***]
   (calculus, algebra, routine, nonroutine, applied)
3. Apply principles of logic to develop and analyze conjectures and proofs. [L***ogical Reasoning***]
   (quantifiers, breaking down mathematical statements, counterexamples)
4. Demonstrate competence in using various mathematical tools, including technology, to formulate, represent, and solve problems. [***Problem Solving***]
   (calculus tools, algebra tools, applied tools, nonstandard problem solving)
5. Demonstrate proficiency in communicating mathematics in a format appropriate to expected audiences. [***Communication***]
   (written, visual, oral)