

## Independent Study: MTH 499 – Introduction to Number Theory

**Nature of the course:** Number theory studies the properties of natural numbers, or more generally integers. In this independent study, students will learn about classical properties of integers, including divisibility, congruence, primes, and other properties of integers, and learn more about the history and development of some of these results, as well as current status of some famous number theory conjectures and some applications of number theory.

The detailed list of the topics we plan to cover is as follows, along with appropriate resources:

- Divisibility properties and Euclidean algorithm
- Primes, and famous prime number results and conjectures
- Congruences, Diophantine equations, Fermat's little theorem, Chinese Remainder Theorem
- Quadratic residues, quadratic reciprocity
- Cryptography
- (If time) Arithmetic functions
- There is no required textbook. Instead we will use my handouts prepared using sources *Elementary Introduction to Number Theory*, Calvin T. Long, Prentice Hall, 1987 (3rd edition) and *Introduction to Number Theory*, Erickson, Vazzana, Chapman&Hall/CRC, 2008 (1st edition) during previous semesters I taught this course as MTH 625. We will also be using online sources where applicable, such as published papers, Online Encyclopedia of Integer Sequences, math history web pages, lecture notes.

### How the students are to be evaluated:

**Required work:** The students will be assigned weekly pre-class and in-class activities and homework. We will meet once synchronously per week, and students will submit discussion/problem solutions online for the activities. Homework assignments are in addition to this work. Students registered for 3 credits will also prepare at least one mini-project (with written and oral presentation component) during the semester on an appropriate topic of number theory of their choice (chosen from topics such as applications of number theory, divisibility rules, and history and current status of famous number theory conjectures).

**Grades:** The grade from the independent study will be determined using a combination of work on activities, homework assignments, participation at the weekly meetings, and the project (if receiving 3 credits). For a grade A, a student is expected to attend all of the meetings unless an emergency prohibits them from doing so, participate actively on online discussions of activity work (submit their work and also interact with others' work in a meaningful way), turn in the required number of problems for all homework assignments (with mostly correct and well-attempted proofs), and submit a well-prepared mini-project. For a grade B, a student is expected to attend almost all of the meetings unless an emergency prohibits them from doing so, participate actively on almost all activity work, turn in all homework assignments with most of the required problems, and submit a well-prepared mini-project.