# Syllabus for Math 125
# Codes and Connections: An Introduction to Number Theory

**Instructor**: Oser                                        **Location**: Seney Hall 215
**Office**: Pierce Hall, 122A                             **Class Time**: T-Th 11:30-12:45PM
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**Phone**: 4-4655

**Office Hours**:  Math Center (in Pierce-Hall) 3-6PM; "Open door" policy at other times, and by appointment.

**Text**:  Joseph H. Silverman, *A Friendly Introduction to Number Theory*
**Supplementary Reader**:  Simon Singh, *The Code Book*

**Course Description**:  Using secret codes, puzzles, and curious mathematical oddities as motivation, this course explores the elementary concepts behind the theory of numbers and their unexpected connections with other major branches of mathematics.

**Content** :  Divisibility; methods of proof (direct, indirect, existence, well-ordering principle, induction); Pythagorean triples; the Fundamental Theorem of Arithmetic; congruences and modular arithmetic; the Euclidean Algorithm; perfect numbers; fast exponentiation; primes and pseudoprimes; Euler's Theorem; the Chinese Remainder Theorem; $\varphi(n)$; shift, affine, substitution, and Vigenere's ciphers; the Enigma Machine; Diffie-Hellman Key Exchange and RSA Public Key methods.

**Course Goals**: Upon successful completion of Math 125, students will:

1. Understand the basic elements of number theory and some of its more interesting applications and connections to other disciplines, especially with regard to cryptography.

2. Have developed the basic skills needed to think abstractly and investigate something mathematically.  That is to say, they will be able to:

    a.  Identify patterns,
    b.  Make and test conjectures,
    c.  Prove and generalize their results.

**Grading**:  Students' grades are determined by performance on homework, investigations, projects, quizzes, tests, and a *comprehensive* final exam.   All tests will be administered during class.

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| Homework /Quizzes | 150 points |
| Investigations/Code-Breaking Activities | 100 points |
| Project | 150 points |
| Tests (3) | 400 points |
| Final Exam | 200 points |
| Total | 1000 points |

Maximum grade cuts are as follows: 90% - A, 80% - B, 70% - C, 60% - D.  Plus/minus grades may be assigned for percentages near the maximum grade cuts.

**Homework/Quizzes**:  The intent of the homework exercises is to practice necessary skills and techniques found in number theory, cryptography, and the other topics found in this course.  Timely completion of these assignments is expected and will serve as an excellent preparation for the quizzes and tests.  An undetermined number of homework assignments will be collected for a grade.   An undetermined number of quizzes will also be given.  Quizzes need not be announced ahead of time.  There are no provisions for making up a quiz, although there will be 10% extra-credit built into each quiz to accommodate unavoidable absences.  A weighted average of the grades given on homework assignments and quizzes will determine how many of the 150 points for homework/quizzes are earned towards the overall grade.

**Investigations**:  Many of the exercises in the text or otherwise assigned for this course are investigatory in nature.  The instructor will identify which of the exercises assigned fall into this category.  Investigations are to be carefully documented in a log format.  They will be turned in some number of times during the semester.  The format of these logs will include specific mention of data accumulated, patterns found, conjectures made, tests conducted, proofs found, and generalizations – as possible.

**Code-Breaking Activities**:  There will be multiple opportunities to demonstrate one's ability to "break secret codes" using ideas discussed in class, in the reader, and in supplementary material provided by the instructor.

**Project**:  Towards the end of the semester, students will be asked to engage in mathematical research on a problem of their choosing – subject to instructor approval.  The student will be asked to present both a written and a recorded presentation of their findings.

**Tests**:  Three tests will be given (in class, at dates to be announced later).  Students are expected to be present for all scheduled tests. Any conflicts should be brought to the instructor's attention as soon as possible. If a legitimate reason exists for missing a test – as determined by the instructor – then the test must be taken prior to the regularly scheduled date. In the unusual circumstance where taking the test early is not possible, students should be aware that any make-up tests given will likely be designed to be

more difficult to offset the additional time given for study. Students must provide written documentation in advance of any special accommodations required for testing. This includes additional time or other needs.

**Class Attendance**:  Students are responsible for all material covered in class and any changes to the syllabus that may be announced. Any conflicts between the course schedule and religious holy days are to be negotiated in advance with one's instructor.

**The Math Center Online**:  The math center's website, http://mathcenter.oxford.emory.edu/, will be an essential resource for students in this class.  It will contain the calendar for the course, as well as notes and assignments. Students are responsible for all content related to Math 125 posted on this site.

**Calculators**:  The student will need a simple scientific calculator (that adheres to the order of operations) to use for this class.  The calculator need not be a graphing calculator, or one that can be programmed, although this is welcome.  Students will be allowed to use calculators on any quizzes or exams.

**"Good Style"**: All necessary work must be correctly shown in a clear and organized fashion for full credit. Organization and clarity of thought are essential to mathematical thinking. Therefore, points will be deducted for a lack of organization, illegible or sloppy work, and/or the inappropriate use of mathematical symbols, even if answers found are correct.  Students will be provided examples of what is considered "acceptably clear and organized work". The goal is for students to be able to solve problems in "good style", unaided by books, notes, tutors, or calculators – and to understand the reasoning behind the solution method.

## Resources

**Tutoring**:  Paul Oser, the Math Center Director, is available for free, individual tutoring in the Math Center in Pierce Hall from 3-6 PM Mondays through Thursdays. Students are encouraged to do your homework in this area, where help is available as needed.