MATH 321: Number Theory

TR 9:45 – 11:15
Gruening 301
http://www.dms.uaf.edu/∼eallman/classes/321/321-2014.html

Instructor: Elizabeth S. Allman

Contact Details: Chapman 308B, e.allman@alaska.edu, and 474-2479.

Office Hours: (tentative) Tu 8:30, W 9:00, Th 11:30 and by appointment.

Prerequisites: Math 215 with a grade of C or better.

Textbook: *Elementary Number Theory and its Applications*, 6th ed., by K. Rosen, Addison Wesley

Midterm: Tuesday, October 28

Final Exam: Thursday, December 18, 8:00 – 10:00 am

Course Overview and Goals:

Number theory is the field of mathematics concerned with properties of the integers: *When is an integer z the sum of two squares? What are the integer solutions to $x^3 + y^3 = z^3$?* The field is rich in both theory and application, and relies on techniques from algebra, analysis, geometry, and combinatorics. Our course will be an introduction to number theory, and thus will assume only familiarity with ideas from 215 (induction, proof techniques). Stated otherwise, you will need some mathematical maturity, but not any specific knowledge as a prerequisite.

We begin by reviewing some elementary properties of the integers, then progress to studying Diphantine equations, applications of congruences, cryptography, primitive roots of unity, quadratic residues, and, time permitting, the Gaussian integers. Ideas from number theory are very important in the applied fields of network security, coding and cryptography. Significant time will be spent in studying how number theory is used in applications. As such, you will need access to a computer with software like MATLAB or Maple, or some free equivalent. The website to accompany Rosen's book suggests that we use PARI/GP, a free software package widely used by researchers interested in number theory. We will implement a number of algorithms as part of homework assignments with the goal of understanding more fully how theory is used in practice.

Course Mechanics:

Class meetings will be run as interactive lectures, to the extent possible given the enrollment. That means that while I will be presenting material at the board, and you will be taking notes, I will also be asking for suggestions, ideas, and questions about the material as we go along. I don't expect 'correct' answers, but I do expect you to be actively following and participating — that makes the class more interesting for us all.

Class attendance is expected, although I will not formally take roll. If you miss a class, you should get notes from another student. Homework assignments will be posted on the course web page, and you should make it a habit to check for new problems after each class.

Homework will be assigned weekly, possibly with some adjustments for timing, and picked up from my mailbox Thursday afternoon. At the beginning of class, there may be a little time for simple questions on homework, but you should expect to get your homework questions answered during office hours. There is an emphasis on proof-writing and communication of cogent arguments in number theory, and substantial time and effort must be expended to develop clear and lucid solution-writing techniques.

I encourage you to work with others on the homework, and to share ideas for solutions, but you must *write up solutions independently.* You will learn nothing from simply copying a solution. Even though you may find you can't do every problem, you must make a reasonable attempt on them all. The entire homework assignment will be checked to be sure you have attempted everything. Selected problems will be graded more completely.

Homework will be accepted until 5 pm on its due date, either at my office or in my mailbox in the math department office. I will not accept *any* late homework that has not been cleared ahead of time or is not due to a genuine emergency (e.g., a death in the family).

Missed examinations that are not approved in advance will result in an 'F' on that exam. No make-up exams will be given except in extreme circumstances (e.g., family death, documented illness, etc.). Notifying me by email or a note that you will miss an exam is not sufficient for advance approval; you must speak with me to be excused.

Auditing of this course will only be allowed for those who agree to attend regularly, as evidenced by completion of the midterm exam and all homework assignments.

Examinations:

The midterm exam will be 1.5 hours in length, requiring both an understanding of definitions and statements of theorems, and proving some relatively straight-forward statements. The final examination will consist of two parts: an in-class part that will focus on definitions, examples, and 'routine' proofs, and a take-home part that will consist of more challenging proofs which you will be able to work on for at least several days. For the take-home parts you will be able to refer to your textbook, class notes, and homework, but nothing else. If for any reason I believe that a take-home final examination is not a good option for this class, then only an in-class examination will be given.

Any form of cheating on these exams will be dealt with harshly. At a minimum, the full examination (take-home and in-class) will receive a score of zero. Depending on my concern with the extent of cheating, any incident may result in a course grade of F, and I may also request a University Disciplinary and Honor Code Committee hearing which could result in suspension or expulsion. Please note that evidence of collaboration on work in mathematics is usually obvious, so even if your personal honor is worth nothing to you, cheating is a foolish risk to take.

For missed examinations that are not approved in advance, no make-up exams will be given except in case of emergencies.

Grades:

As mentioned above, there will be a midterm exam and a cumulative final exam, and weekly homework assignments in MATH 321. Grades will be assigned using the following weights:

Homework	30 %
Midterm	30 %
Final Exam	40 %

Grade Bands: A, A- (90 - 100%); B+, B, B- (80 - 89%); C+, C, C- (70 - 79%); D+, D, D- (60 - F%); 69 (0 - 59%). On rare occasion, I may lower the thresholds. Also, in an effort to reward the student who makes significant improvement over the course of the term, a stellar grade on the final may overcome a deficiency on the midterm and improve a student's final grade.

Other Policies:

Course accommodations: If you need course adaptations or accommodations because of a disability, please inform your instructor during the first week of the semester, after consulting with the Office of Disability Services, 203 Whitaker (474-7403).

University and Department Policies: Your work in this course is governed by the UAF Honor Code. The Department of Mathematics and Statistics has specific policies on incompletes, late withdrawals, and early final exams, some of which are listed below. A complete listing can be found at

`http://www.dms.uaf.edu/dms/Policies.html`.

Prerequisites: The prerequisite for MATH 321 is MATH 215 with a grade of C or better. Students not meeting this prerequisite are not eligible to take this course and will be dropped.

Late Withdrawal: This semester the last day for withdrawing with a 'W' appearing on your transcript is October 31. If, in my opinion, a student is not participating adequately in the class, I may elect to drop this student.

Graded Coursework: Please keep all graded work for MATH 321 until final grades have been assigned.

Academic Honesty: Academic dishonesty, including cheating and plagiarism, will not be tolerated. It is a violation of the Student Code of Conduct and will be punished according to UAF procedures.

Courtesies: As a courtesy to your instructor and fellow students, please arrive to class on time, turn your cell phones and iPods off during class, and pay attention in class.