Course Information

Course Number:	Math 3125
Course Name:	Survey of Algebraic Number Theory
CRN:	22136
Location:	MCS 103
Class Hours:	10:50-11:50 Tuesday
Textbook:	N/A
Prerequisites:	Math 2335
Corequisites:	Math 3360

Instructor Information

Name:	Dr. Jeffrey Beyerl
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Office Hours:

Monday	10:00am
Tuesday	10:00am
Wednesday	10:00am*
Thursday	10:00am

*The office hours on Wednesday are in the MRC

Question: Can I only come during office hours?
Answer: You can come anytime! I am typically in my office from 8am until 4pm; office hours are merely designated times that I avoid scheduling meetings or running errands.

Course Description

What is algebraic number theory? It is the application of algebraic structures to number theory. But more informally, consider it as the field of mathematics that creates and then solves the following problem:

Do integers factor uniquely?

First we'll expand the notion of integers until the answer is "NO!" Then we'll fix it up, duct tape it, and shake it around until the answer is a resounding "Yes!!!" It will be a wondrous tour into fixing a problem you never knew existed by applying some of the most advanced algebraic structures available to us.

Grading Policy

Your grade will be based on performance in class as measured by three criterion:

- Willingness to take academic risks in terms of engaging in class discussions.
- Knowledge of material from readings.
- Familiarity with specific problems assigned based on readings.

Student Learning Objectives (Subject to change throughout the semester)

- Be able to determine whether or not a ring of the form $\mathbb{Z}[\alpha]$ with $\alpha \in \mathbb{C}$ is a Euclidean Domain
- Be able to solve certain Diophantine equations whose solution methods rely on relevant principles in algebraic number theory.
- Be able to determine the ring of integers of a specified number field.
- Be able to relate integers to ideals.
- Be able to work with ideals to solve problems that cannot be acceptably solved with integers.
- Be able to factor ideals and determine when they are prime.
- Be able to identify when a specified prime stays prime in an extension ring, versus when it splits or is ramified.

Course Materials

- The primary text for this class will be Matt Baker's text on algebraic number theory. The course will cover essentially the first chapter of this text, and then other selected topics. http://people.math.gatech.edu/~mbaker/pdf/ANTBook.pdf.
- Keith Conrad's notes on the Gaussian Integers http://www.math.uconn.edu/~kconrad/blurbs/ugradnumthy/Zinotes.pdf
- Henri Cohen's slides from the Arizona Winter School on Eplicit Methods for Solving Diophantine Equations. http://swc.math.arizona.edu/aws/2006/06CohenLectures.pdf
- The Math 3360 text, A First Course in Abstract Algebra by Anderson and Feil

Assignments

1. Read sections 1 & 2 (pages 1-3) in Keith Conrad's notes on the Gaussian Integers. Then think about this problem (It's related to the class, I promise!!):
   Let T be a right triangle with integer sides. It is possible that all three side lengths have a common factor. Strip away the greatest such common factor to obtain a smaller right triangle T' whose side lengths are coprime. Prove that the longest side does not have a factor of 3.
2. Read section 35.1 & 35.2 in Abstract Algebra. Do problems 4 and 6(a,b).
   Read sections 1.1 and 1.2 in Baker's text, then do problem 1
3. Thoroughly read page 3 in Baker's text – figure out what details are missing and try to add them in. Do problems 2 and 3 in Baker's text.
   Read slides 1-7, 23, 33 in Henri Cohen's slides. Slide 33 is a crash-down-the-waterfall introduction to this course. Determine what on this slide you recognize and make sense of it; also take note of what you don't recognize.

4. Read section 1.4 in Baker's text.
   Find definitions for the following terms: (May need chapter 42 in Abstract Algebra)
   - Field
   - Field Extension
   - Degree of an extensions
   - Algebraic number in $\mathbb{R}$
   - Algebraic field element in E over F
   - Minimal Polynomial

   Do problems 4 and 6 in chapter 42.
5. Look up, illustrate with an example, and prove Fermat's Little Theorem
   Look up, illustrate with an example, and prove Eisenstein's Criterion
   Read section 1.5 in Baker's text
6. Read pages 7 and 8 in Baker's text.
   Do problem #4 in chapter 41 and #10 in chapter 43 of Abstract Algebra.
7. Read pages 9 and 10 in Baker's text
   Read chapter 39 in Abstract Algebra and do problem #9

Attendance Policy
Your active participation in this course is expected and required for you to learn the material and earn a passing grade. If you fail to regularly and actively participate it will demonstrate that you are not making a reasonable effort to complete this course, and you will be administratively dropped for non-attendance with a grade of WF.

Academic Integrity Statement
The University of Central Arkansas affirms its commitment to academic integrity and expects all members of the university community to accept shared responsibility for maintaining academic integrity. Students in this course are subject to the provisions of the university's Academic Integrity Policy, approved by the Board of Trustees as Board Policy No. 709 on February 10, 2010, and published in the Student Handbook. Penalties for academic misconduct in this course may include a failing grade on an assignment, a failing grade in the course, or any other course-related sanction the instructor determines to be appropriate. Continued enrollment in this course affirms a student's acceptance of this university policy.

Americans with Disabilities Act Statement
The University of Central Arkansas adheres to the requirements of the Americans with Disabilities Act. If you need an accommodation under this Act due to a disability, please contact the UCA Office of Disability Services, 450-3613.

Sexual Harassment and Academic Policies Statement
All students are required to familiarize themselves with the University of Central Arkansas policy on sexual harassment and on academic policies. These policies are printed in the Student Handbook.

Building Emergency Plan Statement
An Emergency Procedures Summary (EPS) for the building in which this class is held will be discussed during the first week of this course. EPS documents for most buildings on campus are available at http://uca.edu/mysafety/bep/. Every student should be familiar with emergency procedures for any campus building in which he/she spends time for classes or other purposes.