Syllabus: MTH 412 Abstract Algebra

Spring 2013, Sections 001

Instructor: Dr. Keith Hubbard
Class Times & Place: MWF 9-9:50, Math 357
E-mail address: hubbarke@sfasu.edu
Office: Math 336
Office Phone: 936.468.1533
Website: http://www.faculty.sfasu.edu/hubbardke/

Office Hours: MWF 8-9; TR 1:30-3; W 2-5

Required Materials

Course Description
Introduction to the study of algebraic systems with particular emphasis on concrete examples of the basic algebraic structures, groups, rings, integral domains, and fields.

Course Objectives
At the end of this course, successful students will be able to:

- Recognize and prove theorems about equivalence relations, group structures, and basic ring structures.
- Recognize cyclic groups and apply the fundamental theorem of cyclic groups.
- Recognize subgroups and prove that a given subset of a group is a subgroup.
- Construct and manipulate group and ring homomorphisms.
- Read and construct Cayley diagrams.
- Connect the definitions to their common applications in lower level mathematics.
- Recognize and interpret theorems to prove properties about specific algebraic structure.
- Use the skills of proof by contradiction, proof by contraposition, and proof of set equality.
- Test a potential isomorphism for being well-defined, a homomorphism, one-to-one and onto.
- Understand mappings and use definitions of one-to-one, onto, well-defined, homomorphism, isomorphism and others to characterize a given map.
- Create factor groups and interpret elements of factor groups accurately.
- Recognize and construct classic examples of rings, integral domains and fields.
- Interpret permutations and symmetries in a group theoretic context.

Final Grade Components

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework/Quizzes</td>
<td>25%</td>
</tr>
<tr>
<td>Project/Presentation</td>
<td>10%</td>
</tr>
<tr>
<td>Tests (2 @ 20% each)</td>
<td>40%</td>
</tr>
<tr>
<td>Comprehensive Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Final Course Grade</td>
<td>100%</td>
</tr>
</tbody>
</table>

Test Dates (tentative)

#1: February 27 – March 1
#2: April 10 – April 12
Final: May 6, 8-10AM

General Policies and Information

- At the beginning of class, you may ask questions on material covered the previous class period.
- You earn your grade by communicating your understanding of the material through the homework, the project and tests. Clearly communicating mathematics will be essential in this course.
- I will send e-mails to the entire class during the semester. Check your SFA e-mail account frequently.
- To contact me, you may call my office, drop by my office, or e-mail me. I will do my best to reply quickly.
- Students are expected to respect the learning environment of their fellow students. Towards this end, use of mobile phones, mp3 players, etc., is forbidden during class.

Testing, Grading, and Make-up Policies

- If you miss a test and have a valid excuse, I will replace your missed test grade by your final exam grade. However, your final may only replace one other score.
- Attendance Policy: Over 3 unexcused absences may result in a grade reduction.
- Since you have a full semester to arrange any travel plans, they are not an excuse for missing the final.
- Students are expected to attend every class meeting, arriving on time. If you have 3 or less absences and score a 70% or better on the final, that score may replace your lowest test grade. If a student leaves class early without permission, the student will be marked absent.
You may get help on work that is assigned to be done outside of class, unless otherwise instructed, but I expect any work that you turn in to reflect your own work. On in-class graded work, I expect you to only use your brains, pencil, paper, and, sometimes, a calculator.

**Tips for a Successful math class**
- Measure success as understanding and being able to do new problems, not as having completed the assignment.
- Try to understand definitions and solving approaches. See if you can find examples that work and examples that don’t.
- Take the time to read the book and review your notes before and after class.
- Practice homework problems until you can do it without referring to examples or help from your notes.
- Practice explaining big ideas and problem solving procedures in your own words, using complete sentences.
- Have someone check your work after you have finished it to help eliminate mistakes that you do not know you are making.
- Treat mistakes as a learning experience.
- Realize that math is hard. Some parts are harder for some people than others. Ph.D. mathematicians frequently find it hard to learn new things sometimes and make mistakes on things we already know. We have just learned to go back and refresh the basics, and keep working, even it takes hours, days, weeks, or years.
- Some people take longer to understand things than others. Evaluate how you study and seek to study smarter, not necessarily longer. If you are still stuck, get some help. The AARC and I are here for you!

**University Policies**
- **Academic Integrity (A-9.1)** Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.
  - **Definition of Academic Dishonesty** Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one’s own work when, in fact, it is at least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one's paper without giving the author due credit.
  - Please read the complete policy at [http://www.sfasu.edu/policies/academic_integrity.asp](http://www.sfasu.edu/policies/academic_integrity.asp)
- **Withheld Grades Semester Grades Policy (A-54)** Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average. The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a minimum projected grade of C.
- **Students with Disabilities** To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to [http://www.sfasu.edu/disabilityservices/](http://www.sfasu.edu/disabilityservices/).
Course Content:

- **The tentative schedule** for material to cover includes the following:
  1.1 The Division Algorithm
  1.2 Divisibility
  1.3 Primes and Unique Factorization
  2.1 Congruence and Congruence Classes
  2.2 Modular Arithmetic
  2.3 The Structure of \( \mathbb{Z}_p \) and \( \mathbb{Z}_n \)
  3.1 Definition and Examples of Rings
  3.2 Basic Properties of Rings
  3.3 Isomorphisms and Homomorphisms
  4.1 Polynomial Arithmetic and the Division Algorithm
  6.1 Ideals and Congruence
  6.2 Quotient Rings and Homomorphisms
  7.1 Definition and Examples of Groups
  7.2 Basic Properties of Groups
  7.3 Subgroups
  7.4 Isomorphism and Homomorphisms
  8.1 Congruence and Lagrange’s Theorem
  8.2 Normal Subgroups
  8.3 Quotient Groups
  8.4 Quotient Groups and Homomorphisms

- **Homework** – I will assign homework from the sections as we discuss them. Homework must be turned in on clean paper (not torn from a spiral) and must be stapled (not folded in the corner and torn) to be graded. It is imperative that you keep your studies current. If needed, we will discuss questions over homework that you have attempted at the beginning of each meeting. Be sure that you are prepared to ask questions over material that we discussed in the previous meeting. You should come to speak with me during my office hours if your questions do not address the section covered in the previous meeting.

- **Definitions/In-Class Quizzes** – Without knowing the meaning of the terms we will be using, you will be unable to follow class discussion or even attempt to solve problems. Quizzes will be given on the basic definitions and the statements major theorems.

- **Reading/Online Quizzes** – Reading the material in the textbook which parallels our class discussions adds do your understanding of the material. Reading mathematic is also, in itself, an exceptionally important skill which you will need when you graduate college. Quizzes will be given on Blackboard, through mySFA, to encourage your reading comprehension. They will generally be due before class on days for which reading assignments are due.

- **Presentations** – The ability to clearly communicate material which you have mastered is every bit as important as mastering the material. If you can’t communicate it, why know it? With that purpose in mind, each student will present a piece of mathematics to the rest of the class and each member of the class will give constructive feedback. These presentations will be clustered toward the end of the course.

- **Project/Conference** – It is important to understand that mathematics is continually being discovered and created. Hopefully, you will one day contribute to it yourself. For this course you will choose one of the following excellent ways to understand the creative side of mathematics.
  - Read an original paper where an author describes mathematical concepts for the first time. The abstract definition of ‘group’ came to us through an 1854 paper written by Arthur Cayley. (This paper also introduces the concepts of a ‘Cayley table’ and of a ‘group algebra’.) Write a 2 page paper on the reason Cayley introduced an abstract definition of group, and what that definition seems to entail.
  - Attend a conference where current mathematicians (students, professors, and others) present mathematics that they have worked on. The Texas Section of the Mathematical Association of America will hold a conference April 8-10 at Abilene Christian University. Attend the conference and write a 1 page summary of the mathematics you observed.

Since both of these are great experiences, you may choose to do both and use one of these scores to replace any other class day’s quizzes and homework.