Abstract Algebra Syllabus

YEAR COURSE OFFERED: 2016
SEMESTER COURSE OFFERED: Fall 2016
DEPARTMENT: Mathematics, Comp. Sci. and Coop. Engineering
COURSE NUMBER: Math 4338 A
NAME OF COURSE: Abstract Algebra
NAME OF INSTRUCTOR: Dr. Mary Flagg
flaggm@stthom.edu
713-525-3187
216 Math House
OFFICE HOURS: Monday 3:00-4:30
Tuesday 9:30-11:00
Wednesday 9:30-12:00
Thursday 9:30-11:00
Or by appointment

The information contained in this class syllabus is subject to change. Students are expected to be aware of any additional course policies presented by the instructor during the course.

Course Description

Fundamentals algebraic structures: operations within them and relations among them. Groups, rings and fields. Prerequisite: Math 2340.

Required Reading

Abstract Algebra: An Introduction, 3rd Edition by Thomas W. Hungerford
Cengage Learning, 2014

Learning Outcomes

1. Students will analyze the algebraic structure of sets of numbers, sets of polynomials and sets of symmetries of a plane figure and identify the key abstract properties of each set. Students will connect the essential properties of these concrete sets with the abstract constructions of groups, rings and fields.
Abstract Algebra Syllabus

2. Students will classify systems as groups, rings or fields and identify the substructures in each system and the relationships between systems.

3. Students will apply the framework of abstract algebraic structures to solve concrete problems in cryptography, coding theory, computer arithmetic with large numbers or similar topics.

4. Students will deepen their conceptual understanding of algorithms and definitions in high school algebra through the lens of formal abstract theory.

Major Assignments/Exams

Grades will be based on homework, a major project, two semester tests and a final.

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework and Class Participation</td>
<td>20%</td>
</tr>
<tr>
<td>Project</td>
<td>15%</td>
</tr>
<tr>
<td>2 Semester Tests</td>
<td>40% (20% each)</td>
</tr>
<tr>
<td>Final</td>
<td>25%</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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Tests

The semester tests will be given during class on the dates announced. The final will be at the time specified by the Current Final Exam schedule. A student will not be allowed to use any notes or books during tests.

Project

Students, individually or in pairs, will choose an application of algebra:
- A topic from the textbook (Chapters 13-16)
- A research project on education topics in algebra
- An algebra-graph theory research project

Each individual will turn in a 4-6 page written report. Each group will present a 20 minute lesson to the class explaining their topic. More specifics on the report and presentation will be given during class.

Homework

Homework will be assigned from each section of the text we cover. Homework is due ON TIME, IN CLASS on the day specified by the homework calendar. The lowest homework grade will be dropped. **Late homework will not be accepted.**

Grading Scale

If your average is “x”
- **A:** 93 ≤ x ≤ 100
- **A-:** 90 ≤ x < 93
- **B+:** 87 ≤ x < 90
- **B:** 83 ≤ x < 87
- **B-:** 80 ≤ x < 83
- **C+:** 77 ≤ x < 80
- **C:** 73 ≤ x < 77
- **C-:** 70 ≤ x < 73
- **D+:** 67 ≤ x < 70
- **D:** 63 ≤ x < 67
- **D-:** 60 ≤ x < 63
- **F:** x < 60

Classroom Etiquette

Class Attendance is mandatory. Students are allowed 3 absences during the semester. After the third absence, unexcused absences will count against your homework and class participation.
Abstract Algebra Syllabus

average. Students with documented extreme circumstances will not be penalized. However, if a student is unable to attend class on a regular basis, it is very likely the student will not complete the course successfully.
Please turn your cell phones to silent during class.
Students are encouraged to form study groups and discuss the course material with their classmates. However, written material should be YOUR OWN WORK in your own words. Copying a proof from a fellow student is considered a violation of the academic honesty policy.

Accommodations

The University of St. Thomas abides by the Americans with Disabilities Act and Section 504 of the Rehabilitation Act of 1973, which stipulates that no student shall be denied the benefits of an education "solely by reason of a handicap." If you have a documented disability that may impact your performance in this class and for which you may require accommodations, you must be registered with and provide documentation of your disability to Counseling and Disability Services which is located on the second floor of Crooker Center. Contact them at 713-525-6953 or campus extension 2169.

Blackboard Resources

This course will be managed with Blackboard. You may find the login for blackboard on your My StThom page. Use your CELT login ID and password to access blackboard.
Course syllabus, calendar, homework assignments, reminders, announcements and discussions will be found in Blackboard.

List of discussion/lecture topics

Course Outline
Chapter 1: Arithmetic in Z Revisited
1.1 The Division Algorithm
1.2 Divisibility
1.3 Primes and Unique Factorization

Chapter 2: Congruence in Z and Modular Arithmetic
2.1 Congruence and Congruence Classes
2.2 Modular Arithmetic
2.3 The Structure of \( \mathbb{Z}_p \) (p a prime) and \( \mathbb{Z}_n \)

Chapter 3: Rings
3.1 Definition and Examples of Rings
3.2 Basic Properties of Rings
3.3 Isomorphism and Homomorphism

Chapter 4: Arithmetic in \( F[x] \)
4.1 Polynomial Arithmetic and the Division Algorithm
4.2 Divisibility in \( F[x] \)
Abstract Algebra Syllabus

4.3 Irreducibles and Unique Factorization
4.4 Polynomial Functions, Roots and Reducibility
4.5 Irreducibility in \( \mathbb{Q}[x] \)
4.6 Irreducibility in \( \mathbb{R}[x] \) and \( \mathbb{C}[x] \)

Chapter 5: Congruence in \( F[x] \) and Congruence Class Arithmetic
5.1 Congruence in \( F[x] \) and Congruence Classes
5.2 Congruence Class Arithmetic
5.3 The Structure of \( F[x]/p[x] \) when \( p \) is a prime

Chapter 6: Ideals and Quotient Rings
6.1 Ideals and Congruence
6.2 Quotient Rings and Homomorphism

Chapter 7: Groups
7.1 Definitions and Examples of Groups
7.2 Basic Properties of Groups
7.3 Subgroups
7.4 Isomorphism and Homomorphism
7.5 The Symmetric and Alternating Groups*

Chapter 8: Normal Subgroups and Quotient Groups
8.1 Congruence and Lagrange’s Theorem
8.2 Normal Subgroups*
8.3 Quotient Groups*
8.4 Quotient Groups and Homomorphism*

Sections marked with a * will be covered if time permits.

Important Academic Calendar Dates
August 22 First Day of Class
August 26 Last Day to Add a Class
September 5 Labor Day Holiday
October 10-11 Fall Break
November 4 Last Day to Drop with a W
November 23-25 Thanksgiving Break
December 5 Last Class Day for Fall
December 6 and 9 Study Days
Final Exams December 7-15
OUR FINAL Tuesday, December 13, 11:00-1:30 in our classroom.
Abstract Algebra Syllabus

CALENDAR

*** This is SUBJECT TO CHANGE***
Changes will be announced in class and posted in blackboard.

<table>
<thead>
<tr>
<th>Week</th>
<th>Tuesday</th>
<th>Topic</th>
<th>Thursday</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug. 23</td>
<td>Intro, Symmetry and the Symmetric Group</td>
<td>Aug. 25</td>
<td>Equations, Polynomials and Solution by Radicals</td>
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<td>2</td>
<td>Aug 30</td>
<td>1.1</td>
<td>Sept. 1</td>
<td>1.2</td>
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<tr>
<td>3</td>
<td>Sept. 6</td>
<td>1.3</td>
<td>Sept. 8</td>
<td>2.1</td>
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<tr>
<td>4</td>
<td>Sept. 13</td>
<td>2.2</td>
<td>Sept. 15</td>
<td>2.3</td>
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<tr>
<td>5</td>
<td>Sept. 20</td>
<td>3.1</td>
<td>Sept. 22</td>
<td>3.2</td>
</tr>
<tr>
<td>6</td>
<td>Sept. 27</td>
<td>Review</td>
<td>Sept 29</td>
<td>Test 1 Chapter 1-3.2</td>
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<td>7</td>
<td>Oct. 4</td>
<td>3.3</td>
<td>Oct. 6</td>
<td>4.1</td>
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<tr>
<td>8</td>
<td>Oct. 11</td>
<td>FALL BREAK</td>
<td>Oct. 13</td>
<td>4.2</td>
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<td>9</td>
<td>Oct. 18</td>
<td>4.3/4.4</td>
<td>Oct. 20</td>
<td>4.5/4.6</td>
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<tr>
<td>10</td>
<td>Oct. 25</td>
<td>5.1</td>
<td>Oct. 27</td>
<td>5.2/5.3</td>
</tr>
<tr>
<td>11</td>
<td>Nov. 1</td>
<td>6.1</td>
<td>Nov. 3</td>
<td>6.2/6.3</td>
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<tr>
<td>12</td>
<td>Nov. 8</td>
<td>Review</td>
<td>Nov. 10</td>
<td>TEST 2 Chapters 4-6</td>
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<tr>
<td>13</td>
<td>Nov. 15</td>
<td>7.1</td>
<td>Nov. 17</td>
<td>7.2</td>
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<td>14</td>
<td>Nov. 22</td>
<td>7.3/7.4</td>
<td>Nov. 24</td>
<td>THANKSGIVING</td>
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<tr>
<td>15</td>
<td>Nov. 29</td>
<td>Group Wrap and Review</td>
<td>Dec. 1</td>
<td>Last Class – Presentations Final Review</td>
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<tr>
<td>16</td>
<td>Dec. 6</td>
<td>Reading Day</td>
<td>Dec. 8</td>
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<tr>
<td>17</td>
<td>Dec. 13</td>
<td><strong>FINAL EXAM 1:45-4:15</strong></td>
<td>Dec. 15</td>
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