MATH 4320—Introduction to Algebraic Systems  
Department of Mathematics and Statistics  
Class Policy Sheet and Syllabus—Fall 2021

Professor: Dr. Sarah T. Stovall  
Office: 338 Mathematics building  
Email: sstovall@sfasu.edu  
Office Phone: 936.468.1684  
Office Hours: Text me on GroupMe to meet at the times below via Zoom or in my office.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
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Covid statement: I plan to meet you face-to-face daily in our classroom, 357. Please refer to Dr. Scott Gordon’s email that all faculty and staff received on 8/12 regarding Covid recommendations.

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.


Tentative Exam Schedule: Please note that the dates for our in-class exams below are subject to change. The final is university scheduled and cannot be taken at a different time without permission of the Dean of the College of Sciences and Mathematics.

- Exam 1: Friday, September 17
- Exam 2: Friday, October 15
- Exam 3: Friday, November 12
- Final: Monday, December 6, 8-10 in our regular classroom

Grading Policy:  
- 55% First Three Exams (top two 20% each, lowest 15%)  
- 15% Homework  
- 5% Presentations/Participation  
- 25% Comprehensive Final Exam  

Grading Scale:  
- 90% - 100%: A  
- 80% - 90%: B  
- 70% - 80%: C  
- 60% - 70%: D  
- Below 60%: F

Course Requirements:  
- Three in-class exams—If a student must miss an exam due to an excused absence, special arrangements should be made in advance. Cell phones and graphing calculators are not allowed out during exams, even if that is all you brought. No music (even through headphones) is allowed during exams.

- Homework—Homework will be assigned and collected. Completing homework and checking your answers to problems with solutions is your source for daily feedback. Completing homework is also how you become responsible for identifying which topics on which you need to spend more time. Homework will be assigned well in advance of the due date so that you will have adequate time to complete the exercises and to typeset it in LaTeX. If you wait to begin the day before, you will not have enough time.

- Accountability and content delivery (Presentations)—Students are expected to know and be able to recall definitions and theorems to contribute to class discussions. To encourage ownership in preparation, students will present class content during the semester.

- A comprehensive final exam—The final exam is Monday, December 6, 8-10 in our regular classroom.

- Class attendance and participation—Students are expected to attend all class meetings, arriving on time. Bring your text daily. If you are absent, you are responsible for determining what you missed and for being prepared for class when you return. Missing 8 classes drops your course average by one letter grade. Missing 12 classes drops your course average by two letter grades.

- Preparing for class—Students should be prepared to invest several hours per day outside of class reading the text, practicing examples, and working homework exercises. I recommend pre-reading sections before we practice in class (see the tentative schedule).

- Email—Check your university email regularly, as I may send reminders, assignments, or announcements via your @jacks account.

- GroupMe app—Students can use the GroupMe app for texting the instructor. Instructions to join will be given on the first day of class.

- There is no extra credit or alternative credit. Do well enough on the graded items to earn the grade you seek.

COMPLETE COURSE POLICY SHEET ACCESSIBLE ONLINE IN D2L.
### MATH 4320 Course Outline: (Tentative schedule)

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Required Reading</th>
<th>Exercises to Practice (turn in a subset)</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>1.1 The Division Algorithm</td>
<td>2ab, 6, 7, 8, 10</td>
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<tr>
<td></td>
<td>1.2 Divisibility</td>
<td>1f, 5, 12, 15, 20, 25, 28, typo in 15</td>
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<tr>
<td>Week 2</td>
<td>1.3 Primes and Unique Factorization</td>
<td>4, 12, 16, 17, 21, 28</td>
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<tr>
<td></td>
<td>2.1 Congruence and Congruence Classes</td>
<td>4, 8, 14, 15, 16, 20</td>
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<tr>
<td>Week 3</td>
<td>2.2 Modular Arithmetic</td>
<td>9, 10, 13</td>
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<tr>
<td>Week 4</td>
<td>2.3 The Structure of ( \mathbb{Z}_n )</td>
<td>1ab, 2ab, 6, 9, 10, 16</td>
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</tbody>
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**Exam 1**

| Week 5   | 3.1 Definition and Examples of Rings | 2, 8, 20, 25, 32, 33, 39 |
| Week 6   | 3.2 Basic Properties of Rings        | 3, 6, 13, 26, 32, 40, 46 |
|          | 3.3 Isomorphisms and Homomorphisms   | 8, 12, 18, 27, 30 |
| Week 7   | 4.1 Polynomial Arithmetic and the Division Algorithm | 3, 6, 7, 8, 9 |
|          | 6.1 Ideals and Congruence            | 3, 6, 8, 10, 14, 16 |
| Week 8   | 6.2 Quotient Rings and Homomorphisms | 3, 4, 5, 9, 16 |

**Exam 2**

| Week 9   | First Isomorphism Theorem            |
|          | 7.1 Definition and Examples of Groups | 3, 4, 7, 12, 25, 26, 35 |
| Week 10  | 7.2 Basic Properties of Groups        | 5, 9, 15, 21, 23, 24, 27, 28, 34 |
| Week 11  | 7.3 Subgroups                        | 1, 2, 16, 19, 26-29, 38, 39, 40, 43, 44, 45, 46 |
|          | 7.4 Isomorphisms and Homomorphisms   | 8, 16, 20, 22, 25, 26, 39, 41, 42, 49, 50, 51 |
| Week 12  | 8.1 Congruence and Lagrange’s Theorem | 5, 8, 11, 21, 26, 35 |

**Exam 3**

| Week 13  | 8.2 Normal Subgroups                 | 5, 10, 14, 17, 19, 28 |
|          | 8.3 Quotient Groups                   | 2, 9, 12, 24, 25, 26 |
| Week 14  | 8.4 Quotient Groups and Homomorphisms | 1, 3, 6, 20, 23, 30 |

**SFASU Policy 5.4:** The federal definition of a credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates:

1. Not less than one hour of classroom or direct faculty instruction and a minimum of two hours out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or 10 to 12 weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time, or;
2. At least an equivalent amount of work as outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours.

To this end, all students in courses offered by the Department of Mathematics and Statistics that wish to be successful should plan to spend at least two hours outside of class for every credit hour associated with this course. Expected activities to be completed in the time outside of class include reviewing notes from previous class meetings, reading assigned course resources, completing all assigned exercises and projects, and performing periodic assessment preparation.
Academic Integrity

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. The penalty for a student found cheating on any part of an assignment, quiz, or exam in this class will range from a grade of zero on the work to a grade of F in the course, and may result in additional, more severe disciplinary measures. A student who allows another to copy his work and the student copying the work are both guilty of cheating. Do your own work. Do not show your completed work to others. Do not allow others to copy your work.

Definition of Academic Dishonesty [SFA policy 4.1]:
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.

Withheld Grades Semester Grades [SFA Policy 5.5]
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.

Acceptable Student Behavior
Classroom behavior should not interfere with the instructor’s ability to conduct the class or the ability of other students to learn from the instructional program (see the Student Conduct Code, policy 10.4). Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic, or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the Early Alert Program. This program provides students with recommendations for resources or other assistance that is available to help SFA students succeed.

SFASU Mental Health Statement: SFASU values students’ mental health and the role it plays in academic and overall student success. SFA provides a variety of resources to support students’ mental health and wellness. Many of these resources are free, and all of them are confidential.

On-campus Resources:
SFASU Counseling Services  SFASU Human Services Counseling Clinic
www.sfasu.edu/counselingservices  www.sfasu.edu/humanservices/139.asp
3rd Floor Rusk Building  Human Services Room 202
936-468-2401  936-468-1041

Crisis Resources:
Burke 24-hour crisis line 1(800) 392-8343
Suicide Prevention Lifeline 1(800) 273-TALK (8255)
Crisis Text Line: Text HELLO to 741-741

Student Learning Outcomes (SLO): At the end of MTH 4420, a student who has studied and learned the material should be able to:
1. Recognize and prove theorems about equivalence relations, group structures, and basic ring structures. [PLO: 1,2,3]
2. Recognize cyclic groups and apply the fundamental theorem of cyclic groups. [PLO: 1,2,3]
3. Recognize subgroups and prove that a given subset of a group is a subgroup. [PLO: 1,2,3]
4. Construct and manipulate group homomorphisms and isomorphisms. [PLO: 1,2,3]
5. Read and construct Cayley diagrams. [PLO: 1,2,3]
6. Connect the definitions to their common applications in lower-level mathematics. [PLO: 1,2,3]
7. Recognize and interpret theorems to prove properties about specific algebraic structure. [PLO: 1,2,3]
8. Use the skills of proof by contradiction, proof by contraposition, and proof of set equality. [PLO: 1,2,3]
9. Test a potential isomorphism for being well-defined, a homomorphism, one-to-one and onto. [PLO: 1,2,3]
10. Understand mappings and use definitions of one-to-one, onto, well-defined, homomorphism, isomorphism, and others to characterize a given map. [PLO: 1,2,3]
11. Create factor groups and interpret elements of factor groups accurately. [PLO: 1,2,3]
12. Recognize and construct classic examples of rings, integral domains, and fields. [PLO: 1,2,3]
13. Interpret permutations and symmetries in a group theoretic context. [PLO: 1,2,3]

Program Learning Outcomes (PLO): Students graduating from SFA with a B.S. Degree and a major in mathematics will:
1. Written Communication - SFA Mathematics majors communicate mathematical ideas effectively in written form, integrating mathematical notation correctly and consistently.
2. Verbal Communication - SFA Mathematics majors communicate mathematics effectively to diverse audiences.
3. Mathematical Maturation - SFA Mathematics majors grow from a computational understanding of mathematics to an integrated approach which includes critical thinking proficiency, computational facility, conceptual understanding, and problem-solving persistence.
Math 4320–Introduction to Algebraic Systems
Course Syllabus

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.

Credit hours: 3

The following is an excerpt from SFA Policy 5.4:

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Course Prerequisites and Corequisites: MATH 3360 and MATH 3365

Course outline:

- Sets & Binary Operations
  - Basic set theory
  - Equivalence relations
  - Binary operations
  - Binary structures
  - Isomorphic structures
  - Commutativity
  Approximate time spent 15%

- Introductory Group Theory
  - Definitions of group and subgroups
    - Canonical examples
    - Subgroup tests
    - Abelian groups
  - Notions of homomorphism and isomorphism
    - Basic definitions
    - Properties
    - Tests for proving homomorphism
    - Tests for proving isomorphism
  - Cyclic groups
    - Fundamental Theorem of Cyclic Groups
  - Generating Sets and Cayley diagrams
  Approximate time spent 30%

- Permutations, Cosets and Direct Products
  Approximate time spent 25%
Permutation groups
Orbits and cycles
Alternating groups
Cosets
  • Theorem of Lagrange
Direct products
Finitely generated abelian groups

Homomorphisms 15%
  • Definition and intuition of homomorphism
  • Basic properties
  • Tests for proving homomorphism
  • Tests for proving isomorphism
  • Normality and factor groups

Rings and Fields 15%
  • Definition and basic examples of ring
  • Definition and basic examples of integral domain
  • Definition and basic examples of field

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Human Services Room 202
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