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:

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 a minimum of 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.

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  

- 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

- Permutations, Cosets and Direct Products

<table>
<thead>
<tr>
<th>Course outline:</th>
<th>Approximate time spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sets &amp; Binary Operations</td>
<td>15%</td>
</tr>
<tr>
<td>Introductory Group Theory</td>
<td>30%</td>
</tr>
<tr>
<td>Permutations, Cosets and Direct Products</td>
<td>25%</td>
</tr>
</tbody>
</table>
Permutation groups
Orbits and cycles
Alternating groups
Cosets
  • Theorem of Lagrange
Direct products
Finitely generated abelian groups

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

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

Student Learning Outcomes (SLO): At the end of MATH 4320, 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 and ring homomorphisms. [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.

This course meets educator preparation standards for one or more certification programs; a complete listing of all the educator preparation standards this course meets can be found at: https://sfasu.edu/docs/jacksteach/jacksteach-standards-alignment-chart.xlsx.

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.

www.sfasu.edu
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:
- using or attempting to use unauthorized materials on any class assignment or exam;
- falsifying or inventing of any information, including citations, on an assignment;
- helping or attempting to help other student(s) in an act of cheating or plagiarism.

Plagiarism is presenting the words or ideas of another person as if they were one’s own. Examples of plagiarism include, but are not limited to:
- submitting an assignment as one’s own work when it is at least partly the work of another person;
- submitting a work that has been purchased or otherwise obtained from the Internet or another source;
- incorporating the words or ideas of an author into one’s paper or presentation without giving the author 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.

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
www.sfasu.edu/counselingservices
3rd Floor Rusk Building
936-468-2401

SFASU Human Services Counseling Clinic
www.sfasu.edu/humanservices/139.asp
Human Services Room 202
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

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.

Date of document: 08/17/2021