

MTH 5309: Advanced Algebra

Sul Ross State University
Spring 2026

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Course Description Advanced Algebra introduces the fundamental concepts of algebraic structures. Topics include groups and subgroups, cyclic and permutation groups, homomorphisms and isomorphisms, rings, integral domains, fields, ideals, quotient structures, and polynomial rings. The course emphasizes abstract reasoning, proof techniques, and structural understanding of algebra.

TEKS Information on the Texas Essential Knowledge and Skills can be found on the TEA website: <http://www.tea.state.tx.us>

Marketable Skills Students will develop strong logical and analytical reasoning through abstract and proof-based problem-solving, along with the ability to analyze and construct algebraic structures, such as groups, rings, and fields. The course fosters rigorous mathematical thinking, encompassing abstraction, generalization, and pattern recognition, while also refining the ability to communicate complex mathematical ideas clearly and precisely by appropriate notation and logical arguments.

Class Meetings Monday: 6:00 PM-8:45 PM (**Online**),

Required Text Birkhoff, Garret & Mac Lane, *A Survey of Modern Algebra*.

Office Hours Monday, Wednesday, and Friday: 8:30 AM - 12:00 PM; or by appointment.

Course Policies

Attendance Policy

Attendance is mandatory. Students are expected to attend class in person in their classroom of registration unless permission is given for extenuating circumstances. You will be held responsible for all material covered in class or the reading assignments. If you miss a class, it is your responsibility to obtain all notes, assignments, and announcements from someone else in the class. Make-up exams will be given only in the event of an emergency, in which case written justification and/or documentation must be provided and approved.

Communication

I will post course documents, reminders, announcements, and assignments on the Blackboard system. You will also submit homework on Blackboard. I may also occasionally send announcements via e-mail. You should make sure you know how to access and use these tools. You are welcome to e-mail, telephone, or text me. However, if you choose to contact me, please ensure that you state your name at the beginning of any message. I am here to help you! Please ask questions in class, call or text me, email me, or visit my office. If you don't communicate with me, I won't be able to help you.

Grading Policy

Your grades will be weighted as follows:

Participation	10%
Homework/Report	20%
Mid-Term Exam	30%
Final Exam	40%

A student who averages at least 90% will receive an A; at least 80% will receive at least a B; at least 70% will receive at least a C; at least 60% will receive at least a D.

Participation

Your participation grade will be determined based on your class attendance and active participation in class activities. If you consistently attend class, appear to be actively engaged, take notes, and participate in class activities, then you will receive full credit.

Homework/Report

Homework will be assigned for each section covered in the text. You must complete each homework assignment before the next class period. This will allow you to make the most of our time together. To succeed in this course, you must do all the homework assignments on time! We will always discuss the homework in class. You should come to class prepared: make sure to have your textbook and suitable writing materials with you. You may need to submit a report on a selected topic at the end of this semester (before the final exam).

Exams

There will be one midterm exam. You will be notified of the exam date at least two weeks in advance. Make-up exams will be given only in the event of an emergency, in which case written justification and/or documentation must be provided and approved. The comprehensive final exam will take place at the time scheduled by the university, during the final exam period at the end of the semester. The official time and date will be announced once the university publishes the final exam schedule.

Subject Outline

1. **Groups:** Concept and examples of Groupoid, Semi-group, Monoid, and Group. General properties of groups, subgroups, and cyclic groups. Coset and Lagrange's theorem. Normal (invariant) subgroups. Factor (Quotient) groups. Centre of a group, Normalizer, and Centralizer in a group.
2. **Permutations:** Permutation. Symmetric group of permutations. Cyclic Permutation, Transposition. Even and Odd permutations and alternating groups.
3. **Homomorphism and Isomorphism of Groups:** Concept of Homomorphism. Isomorphism, Monomorphism, Epimorphism, and Automorphism, Kernel and Image of a homomorphism. Homomorphism and Isomorphism Theorems. Cayley's theorem. Direct Product of Groups. Classification of groups of small orders.
4. **Rings, Integral domains and Fields:** Definition of Various types of rings with properties and examples. Characteristics of a ring. Ordered integral domains. Subrings. Ideals and Residues Class ring. Principal, Prime, and Maximal ideals. Quotient rings. Ring homomorphism. Isomorphism of rings. Quotient field of an integral domain.
5. **R(x) Direct sums of rings:** Unique Factorization Domains. Euclidean Domains. Principal Ideal Domains. The Polynomial Ring $R(x)$ over UFDR.

QEP Mapped Course

Course Design: Communication Infused

To be successful in college and beyond, many sources (e.g., Morrealle & Pearson, 2008) indicate that communication competencies are essential. Sul Ross recognizes that the current generation of undergraduate university students should receive training to navigate a global world as competent communicators in various contexts and channels of communication.

Through our Quality Enhancement Plan (QEP) called Compass, Sul Ross aims to equip you to navigate excellence in the 21st century by developing your communication skills across multiple courses. This mathematics course is designed to enhance your communication skills. Therefore, this course has the following QEP Student Learning Outcome:

QEP Student Learning Outcome

The student will create works that exhibit skill in prepared and purposeful communication (written, oral, or visual).

University Statements

Distance Education Statement: *Students enrolled in distance education courses have equal access to the university's academic support services, such as library resources, online databases, and instructional technology support. For more information about accessing these resources, visit the SRSU website. Students should correspond using Sul Ross email accounts and submit online assignments through Blackboard, which requires secure login. Students enrolled in distance education courses at Sul Ross are expected to adhere to all policies pertaining to academic honesty and appropriate student conduct, as described in the student handbook. Students in web-based courses must maintain appropriate equipment and software, according to the needs and requirements of the course, as outlined on the SRSU website. Directions for filing a student complaint are located in the student handbook.*

SRSU Disabilities Services: *Sul Ross State University (SRSU) is committed to equal access in compliance with Americans with Disabilities Act of 1973. It is SRSU policy to provide reasonable accommodations to students with documented disabilities. It is the student's responsibility to initiate a request each semester for each class. RGC students seeking accessibility services should contact Paulette Harris, Executive Assistant to the Vice President and Dean, at 830-279-3023 or email pharris@sulross.edu. Ms. Harris's office is at 2623 Garner Field Road, Uvalde, TX 78801 (this is the mailing address, too).*

University Libraries: *The Sul Ross Library offers FREE resources and services to the entire SRSU community. Access and borrow books, articles, and more by visiting the library's website, library.sulross.edu. SRSU RGC students may request InterLibrary Loans (ILLs) and book check outs from the Sul Ross Library to be picked up at the SWTJC library that is most convenient. Access requires your LoboID and password. Librarians are a tremendous resource for your coursework and can be reached in person, by email (srsulibrary@sulross.edu), or phone (432-837-8123). The Southwest Texas Junior College (SWTJC) Library is also available on each campus for your physical use of the space or checking out books. Del Rio, Eagle Pass, and Uvalde students may use online resources available through SWTJC website, library.swtjc.edu. These libraries serve as pickup locations for your ILL or Document Delivery or book requests; to do so, choose the appropriate pick-up location when requesting materials from the Alpine campus.*