

MATH 4301: Modern Abstract Algebra

Sul Ross State University ~ Rio Grande College

Spring 2016

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Course Description MTH 4301 is intended as an introduction to modern abstract algebra.

Course Objectives Students will be introduced to the basic methods of mathematical proof; the integers and divisibility; congruence and modulus arithmetic; group theory; ornamental symmetry; rings; and polynomial rings.

Mathematics Program Outcomes The graduating student will be able to demonstrate content knowledge in mathematics including arithmetic, algebra, geometry, probability, statistics, and calculus.

Class Time Tuesday and Thursday, 12:30 – 1:45 p.m.

Class Location Del Rio 107; Eagle Pass B112; Uvalde B114c

Required Texts Thomas W. Hungerford, *Abstract Algebra: An Introduction*, Third Edition, ISBN 9781111569624

Hermann Weyl, *Symmetry*, ISBN 9780691023748

Office Hours M/W, 12:00 p.m. – 2:00 p.m.; T/Th, 10:30 a.m. – 12:30 p.m.

Course Policies

Attendance Policy

Attendance is mandatory. You will be held responsible for all material covered in class or in the reading assignments. If you have to 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. E-mail is the best way to contact me.

You are welcome to stop by my office if you wish to speak about the content or your progress in the course. Feel free to ask questions in class, call me, or e-mail me.

Grading Policy

Your grades will be weighted as follows:

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| Homework | 25% |
| Book Report | 10% |
| Midterm Exam | 25% |
| 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.

Homework

Homework will be assigned for each section that we cover in the text. Some exercises will be turned in for grading on a weekly basis. These will be submitted as Microsoft Word documents (.docx) on Blackboard. A sample assignment and template will be provided for your convenience.

Although not all of the homework will not be graded for correctness, you should regard it as the most essential component of the course. It is very important that you complete each homework assignment before the next class period. This will allow you to make the most of our time together. We will always have time in class to discuss the homework.

We will not have time to cover all the necessary material in class. You are expected to carefully read each section we work through.

Book Report

In the course of the semester you will read Weyl's *Symmetry* and prepare a book report. Your book report should be at least 2000 words long. The due date is Tuesday, April 12. More details about how to prepare your book report will be provided on Blackboard. You are encouraged to begin as soon as possible and to use the campus Writing Center or Smarthinking to obtain feedback on your writing.

Exams

There will be one midterm exam. Its tentative date is Thursday, March 10. This is subject to change. You will be notified of a change at least one week 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 final exam is scheduled for Tuesday, May 10, from 12:00 – 2:45 p.m. It will be comprehensive.

Subject Outline

I. Arithmetic in \mathbb{Z} Revisited

1. The Division Algorithm: *the Well-Ordering Axiom – the division algorithm*

2. Divisibility: *definition – the greatest common divisor – relative primality*
 3. Primes and Unique Factorization: *prime integers – the Fundamental Theorem of Arithmetic – testing for primality*
- II. Congruence in \mathbb{Z} and Modulus Arithmetic
1. Congruence and Congruence Classes: *congruence modulo n – congruence classes – the set \mathbb{Z}_n*
 2. Modulus Arithmetic: *arithmetic in \mathbb{Z}_n*
 3. The Structure of \mathbb{Z}_p and \mathbb{Z}_n : *notation – the structure of \mathbb{Z}_p where p is prime – units and zero divisors*
- III. Groups
1. Definitions and Examples: *basic definition – permutation groups – dihedral groups – matrix groups*
 2. Basic Properties of Groups
 3. Subgroups: *definition – basic criteria – the center of a group – cyclic subgroups – group generators*
 4. Isomorphisms and Homomorphisms: *isomorphisms and automorphisms – homomorphisms – Cayley's Theorem*
- IV. Symmetry
1. Symmetric and Alternating Groups: *the symmetric group – cycles – transpositions – even and odd permutations – the alternating group*
 2. Ornamental Symmetry: *the rotational group – subgroups – realizations – the dihedral group – direct sums and products – translations – frieze groups – wallpaper groups – polyhedral and crystal groups*

Schedule

This schedule is tentative only. The unit numbers refer to the above outline.

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| Unit I | January 19 – February 16 |
| Unit II | February 18 – March 8 |
| Midterm Exam | March 10 |
| Spring Break | March 14 – 18 |
| Unit III | March 22 – April 12 |
| Unit IV | April 14 – May 5 |
| Final Exam | May 10 |

Americans With Disabilities Act

Sul Ross State University is committed to equal access in compliance with the Americans With Disabilities Act of 1973. It is the student's responsibility to initiate a request for accessibility services. Students seeking accessibility services must contact Kathy Biddick, Student Services Administrative Secretary.