

**COURSE SYLLABUS**

**Course Title: Computational Abstract Algebra**

Abbreviated Title      Comp Abstract Algebra  
As Appears on Transcript

Course Number:    DMAT 431

Credit Hours:    4 credits [semester credit hours]

Course Description: A first course in abstract algebra with emphasis on a computational approach to the subject. Topics include congruence, permutations, groups, homomorphisms, rings, fields, representations with matrices over finite fields, the Fundamental Theorem of Algebra, and solvability questions about polynomial equations, with dual emphases on traditional symbolic proofs and computational investigations.

Prerequisite: Successful completion (C- or higher) of Linear Algebra and Multivariable Calculus or equivalent, or consent of instructor.

Course Workload: 4 semester credit hours • 3 student work hours per credit hour • 14 week Carnegie semester = 168 hours student course workload average

Examination Requirements: Proctored written and oral final examination must be passed at 70% or higher to earn passing grade in course. “B” and “A” grade paths have additional examinations and assignments. See <https://www.distancecalculus.com/grades/> for more information.

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Accredited by New England Commission of Higher Education (NECHE).  
See <https://www.rwu.edu/academics/accreditation/> for more information.

E-Textbook:

*Algebra - A Computational Approach* by John Scherk

Mathematical Software:    Mathematica™ Computer Algebra & Graphing System

**ADA ACCOMMODATIONS**

Roger Williams University has a continuing commitment to providing reasonable accommodations for students with documented disabilities. Students with disabilities who need accommodations in order to fully participate in this class are urged to contact Student Accessibility Services, as soon as possible, to explore

the arrangements needed to be made to assure access. Student Accessibility Services is open Monday through Friday from 8:00AM to 5:00PM Eastern Time; Email: [sas@rwu.edu](mailto:sas@rwu.edu) or Voice: 401-254-3841.

For more information about SAS, visit

<https://www.rwu.edu/undergraduate/academics/student-academic-success/student-accessibility-services-sas>

## **COURSE RULES**

### **Academic Honesty**

Academic Dishonesty in a Distance course includes copying or relying upon another person's work. Working with other students is good and encouraged, but the work you submit for this course must be genuinely your own work. Private tutors are allowed, but you must notify the instructor that you have obtained a private tutor to aid in your studies. Any documented instance of Academic Dishonesty will be grounds for immediate failure in this course.

### **Final (and Other) Examinations**

A written and oral proctored final exam will occur at the student's location over video with the course professor; The student must score 70% or higher on this final exam to be eligible to earn a passing grade in the course.

### **Communication**

Communication is the key to success in a Distance course. It is the student's responsibility to keep good communication channels with the instructors during the course; failure to participate in the course does not constitute "dropping" the course (Withdrawal from the course must be requested in writing to the instructors before the completion date deadline)

### **Roger Williams University Policies & Procedures**

Roger Williams University has Policies & Procedures that all students must follow, including the Roger Williams University Student Handbook. Student must agree to follow all stated rules governing student conduct listed on the Roger Williams University website, and at the [Roger Williams University Course Catalog](#)

### **Course Completion 1 Year Rule**

All Distance Calculus students are afforded 1 Year to finish their course from the Date of Enrollment. Students will be placed in the Academic Semester based upon their Date of Enrollment for academic records purposes. If a student does not finish the course, and does not request a Course Withdrawal for a W, then an "F" grade will be issued.

### **No Chatbots / AI**

Students must pledge to **not** use any Chatbot/AI at all - **period**. Student must pledge to **limit** use of search engines (Google, Bing, etc) to a minimal level. Student must pledge to not engage in dishonest disguise of any Chatbot/AI/Search Engine source of information as student's own honest academic work. Verified chatbot usage will result in an "F" course grade, and will be referred to the Roger Williams University Academic Integrity Committee.

## Learning Outcomes for DMAT 431 - Computational Abstract Algebra

1. To understand and compute congruences and modulo arithmetic
2. To understand and compute permutations
3. To understand axiomatic definition of Groups
4. To understand and compute examples and constructions of Groups, including representations using matrices
5. To understand mappings, homomorphisms, isomorphisms, and kernels
6. To understand and compute cyclic, symmetric, and alternating Groups
7. To understand and compute initial examples of Rings and Fields, both finite and infinite
8. To be introduced to an initial goal of group and ring theory - the insolvability of polynomial equations by roots of degree  $> 4$  (lack of generalization of Quadratic Formula for degree 5 and higher polynomial equations)
9. To understand the goal of the Fundamental Theorem of Algebra

## Syllabus Topics Outline for DMAT 431 - Computational Abstract Algebra

1. Getting Started
  - 1.1 Email and Chat
  - 1.2 Learning About the Course
  - 1.3 Required Hardware
  - 1.4 Software Fundamentals: Mathematica
2. Initial Questions About Polynomial Equations
  - 2.1 Quadratic, Cubic, Quartic Formulas
  - 2.2 Historical Lack of Quintic Formula
  - 2.3 Closer Look at Polynomial Factorizations
  - 2.4 The Question of Coefficients
  - 2.5 The Fundamental Theorem of Algebra
3. Congruences
  - 3.1 Basic Properties
  - 3.2 Divisibility
  - 3.3 Modulo Arithmetic
  - 3.4 Solving Congruences
  - 3.5 The Role of Prime Numbers
4. Permutations
  - 4.1 Mappings
  - 4.2 Cycles
  - 4.3 Signs of Permutations
5. Permutation and Linear Groups
  - 5.1 Definition
  - 5.2 Cyclic Groups
  - 5.3 Generators

- 6. General Groups
  - 6.1 Axiomatic Definition
  - 6.2 Properties
  - 6.3 Homomorphisms
  
- 7. Subgroups
  - 7.1 Orthogonal Groups
  - 7.2 Subgroups and Generators
  - 7.3 Kernel and Image of Homomorphisms
  
- 8. Groups of Symmetries
  - 8.1 Symmetries of Regular Polygons
  - 8.2 Symmetries of Platonic Solids
  - 8.3 Symmetries of Equations
  
- 9. Group Actions
  - 9.1 Orbits and Stabilizers
  - 9.2 Fractional Linear Transformations
  - 9.3 Kernels and Cayley's Theorem
  
- 10. Counting Formulas
  - 10.1 The Class Equations
  - 10.2 Burnside's Counting Lemma
  
- 11. Simple, Sylow, and Abelian Groups
  - 11.1 Finite Fields and Matrix Representations
  - 11.2 Group Examples
  
- 12. Brief Introduction to Rings and Fields
  - 12.1 Definitions and Examples
  - 12.2 Questions About Polynomial Factorization
  - 12.3 Polynomial Equations Revisited
  - 12.4 Fundamental Theorem of Algebra