

## MATH 311: INTRODUCTION TO ABSTRACT ALGEBRA

**Course Number:** MAT 311

**Course Title:** Introduction to Abstract Algebra

**Credits:** 3:3

**Meetings:** MWF 13:00–13:50 PETT 007

**Prerequisites:** Grade of at least C in MAT 253 and MAT 310.

**Instructor Information:**

Instructor: Dr. Igor V. Erovenko [igor@uncg.edu](mailto:igor@uncg.edu)

Homepage: [www.uncg.edu/mat/undergraduate/courses/mat311.html](http://www.uncg.edu/mat/undergraduate/courses/mat311.html)

Office Hours (106 Petty): M 2:00–3:30 WF 12:00–1:00 and by appointment

**For Whom Planned:** This course is part of *Mathematics Major Core*.

**Bulletin Description:** Sets and mappings, equivalence relations, mathematical induction, introduction to theory of groups, rings, and fields.

**Student Learning Outcomes:** Upon successful completion of this course, students shall be able to:

- (1) *Define* equivalence relation, group, subgroup, quotient group, permutation, homomorphism and isomorphism of groups, ring, integral domain, division ring, field;
- (2) *give examples* of equivalence relations, groups, subgroups, cyclic groups, group homomorphisms and isomorphisms, rings, integral domains, fields;
- (3) *compute* greatest common divisor of two integers as a linear combination of the integers, groups of symmetries of regular  $n$ -gons, disjoint cycle decomposition and parity of any permutation, orders of elements of a group, kernels of group homomorphisms;
- (4) *compare* and *contrast* relatively prime and non-relatively prime integers, abelian and non-abelian groups, normal and non-normal subgroups, even and odd permutations, units and zero divisors in a ring;
- (5) *write* a mathematical proof using a typesetting software, *revise* and *rewrite* a proof based on the instructor's critique of the original version;
- (6) *support* and *justify* statements with rigorous mathematical arguments.

**General Education Writing Intensive Student Learning Outcome:**

Students will be able to write in genres appropriate to the discipline(s) of the primary subject matter of the course.

**Teaching Methods and Assignments for Achieving Learning Outcomes:** The course material will be presented via traditional lectures. We will spend a majority of the lecture time explaining how to construct proper proofs, which involves technical writing in the discipline. We introduce many examples of proof technique and style. Achievement of learning outcomes will be facilitated via the following.

*Homework assignments:* The assignments contain problems that require you to come up with and write down a valid mathematical argument in complete English sentences.

*In-class quizzes:* The quizzes ask you to state theorems proved in class and definitions of various terms as well as to illustrate the definitions with examples and/or counterexamples.

*Writing assignments:* The writing assignment consists of typing a detailed argument for a problem and then resubmitting the revised version taking into account my comments on the original version.

*Tests:* There are two tests and a comprehensive final examination.

**Evaluation and Grading:** The following weight distribution is going to be used to determine your final grades:

Writing Assignments	20%
Homework	15%
Quizzes	5%
Tests	30% (two at 15% each)
Final Exam	30%

The following grading scale will be used to determine your final letter grades:

A+	97–100	B+	87–89	C+	77–79	D+	67–69		
A	93–96	B	83–86	C	73–76	D	63–66	F	below 60
A–	90–92	B–	80–82	C–	70–72	D–	60–62		

The following grading criteria are going to be applied to your work:

- *Correctness* — all your statements must be mathematically correct;
- *logical consistency* — every claim you make should be a consequence of an earlier assumption, a consequence of a known theorem or a theorem itself (give a reference), or an implication of earlier claims; your last claim should be precisely what you were asked to prove;
- *completeness* — you need to provide all details necessary to have an argument without gaps;
- *clarity* — all the intermediate assumptions you make should be explicitly stated as such, all your implications need to be transparent, i.e., it should be clear what the “assumption” is and what the “conclusion” is (by now you know the difference between the two).

**Required Texts/Readings/References:** Thomas W. Judson, *Abstract Algebra: Theory and Applications*, open source book available at

<http://abstract.ups.edu> .

**Topical outline/Calendar:**

Week	Material Covered
1	History of the subject; basic proof techniques.
2	Sets, cartesian products and mappings.
3	Equivalence relations and partitions.
4	Well-ordering principle and mathematical induction; the division algorithm.
5	Prime numbers; modular arithmetic; symmetries.
6	Binary operations; groups and their basic properties.
7	Powers of elements in a group; subgroups; cyclic groups.
8	Order of an element of a group; permutation groups.
9	Cycles and transpositions; the dihedral group.
10	Cosets and their properties; Lagrange's theorem.
11	Normal subgroups; quotient groups.
12	Homomorphisms and isomorphisms; Cayley's theorem.
13	Isomorphisms theorems; rings and fields: basic definitions and examples.
14	Integral domains and division rings; Hamiltonian quaternions.

**Academic Integrity Policy:** Students are responsible for familiarizing themselves with UNCG's policy on issues such as cheating, plagiarism, misuse of academic resources, falsification and facilitation of dishonest conduct. Procedures and penalties related to these and other violations of the Academic Integrity Policy are found in the Student Policy Handbook.

[sa.uncg.edu/handbook/](http://sa.uncg.edu/handbook/)

These policies are enforced in this class.

**Attendance Policy:** Regular and punctual attendance is expected. You are responsible for any missed work and material. If you miss a test or the final exam, you should expect a score of zero, unless you have contacted me *in advance* and agreed upon a procedure to make it up. Make-up tests will be allowed with a valid excuse only, which does not include your personal convenience. Early exams cannot be administered for any reason.

**Final Examination:** There will be a comprehensive final examination on Wednesday, December 2, 3:30–6:30 pm.

**Additional Requirements:** UNCG seeks to comply fully with the Americans with Disabilities Act (ADA). Students requesting accommodations based on a disability must be registered with the Office of Accessibility Resources and Services (OARS) in 215 Elliott University Center, 334-5440, ([oars.uncg.edu](http://oars.uncg.edu)).