Dr. Charles Rocca
Higgins Hall 101D
roccac@wcsu.edu
http://sites.wcsu.edu/roccac

MAT 375-01: Algebraic Structures
MW 11-12:15 pm, Higgins 117
Credits: 3 credits
Grading: Standard A-F

Office Hours:

Office hours for the Spring 2016 Semester are on ground in Higgins 101D.

- MTWF 12:45-1:45 pm
- W 3:30-4:30 pm
- or by appointment

If you need to meet virtually we can make an appointment to do so via my WebEx Virtual Office: Higgins 101-DV (https://westconn.webex.com/meet/roccac)

Course Materials:

- Textbook: "Abstract Algebra: An Introduction, 3rd Edition" - Thomas W. Hungerford

Course Description:

In order to have a proper foundational understanding of the numbers and algorithms we use every day one must have knowledge of groups, rings, and fields. This course will introduce the basic ideas in groups, rings, and fields. There will be particular emphasis on field extensions, factorization, and transformations. Students will learn about the fundamental algebraic structures behind the algorithms for arithmetic and polynomials. They will also understand how one number system is developed from another. Prerequisite: C or better in MAT 207 and C or better in MAT 272.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- State the definitions of ring, integral domain, field, and group, and give examples of different types of each of these structures.
- Demonstrate fluency with quotient structures, in particular an understanding of rings of integers modulo n.
- Describe the correspondence between the unique prime factorization of integers and factorization of polynomials into irreducible polynomials.
- Explain familiar facts about arithmetic in terms of ring and field properties.
- Explain the relationship between algorithms for arithmetic of numbers in decimal representation and the arithmetic of polynomials.
- Describe various groups of permutations such as symmetric and dihedral groups and their basic properties.

- Describe the algebraic ways in which some number systems are extensions of others, e.g., the extension of the ring of integers to a field yields the rational numbers.

Course Content:

Units	Topic	Chapters/Sections
1	Ring and Fields: Basic Examples and Definitions	Chap. 1-3, 13
2	Polynomials and Quotients Over Rings	Sec. 4.1-4.4, Chap 5, 6, 14
3	Groups and Their Properties	Chap. 7
4	Cosets and Normal Subgroups in Groups	Sec. 8.1-8.4, 16.1, & 16.2

Grading:

- 8% In Class Packets
- 16% Text Exercises
- 76% Unit Exams (19% each)

Quality of Work Guidelines: All of your out of class work must be neat and professional; answers must be in complete sentences and typed using LaTeX. The quality of your out of class work counts for 10% of your grade.

Unit Exams: You will have four unit exams. The purpose of these exams is to check that you know your fundamental definitions, examples, theorems, and (occasionally) algorithms. The content of these exams represents the fundamental knowledge you should get from the class. Definitions in particular are important to your understanding, as such 40% of each exam will be definitions. You will be given the opportunity to redo some of the questions on each exam in order to earn back up to 40% of your missed points. Since redos are out of class work, they must be typed using LaTeX and be in complete sentences.

In Class Packets: We will have at least two and possibly a couple more packets that we work on in class this semester. Since we are working on these in class, they answers may be hand written.

Problem Solving Exercises: For each unit select 5 problems from different sections from the exercises listed on the next page. For each unit you may do one additional question for extra credit from any section. These problems will require problem solving, these will not be algorithmic problems solved by wrote memorization. You will be allowed to do a second draft on each assignment in order to raise your grade. While you may work in groups on these assignments, cheating will not be tolerated. If you cheat on any part of an assignment you will get a zero on the entire assignment and you will not be allowed to make it up. As out of class work, they must be typed using LaTeX and in complete sentences.

- Unit 1:
  - 1.3: 24, 34
  - 2.3: 14
  - 3.1: 22, 32, 42
  - 3.2: 28, 32
  - 3.3: 16, 24, 30, 36
  - 13: 3,5,6
- Unit 2:
  - 4.1: (11 & 15) as one
  - 4.2: 8
  - 4.3: 16
  - 4.4: 14
  - 5.1: 8
  - 5.3: 2
  - 6.1: (6 & 24) as one
  - 14.1: 14, 18, 20
  - 14.2: 6,7
  - 14.3: 4,5,6
- Unit 3:
  - 7.1: 20, 24, 26, 28
  - 7.2: 20, 25, 26, 30 (use 28)
  - 7.3: 19, 39, 42, 48[1]
  - 7.4: 26, 30, 32, 36
  - 7.5: 22, 24, 30 (use 29)
- Unit 4:
  - 7.4: 26, (28 & 29) as one, 30, 32
  - 8.1: 24, 26, 29
  - 8.2: 16, 18, 20, 26
  - 8.3: 16 (look at the solution to 15), 22, 24, 32
  - 8.4: 22, 24, 26
  - 16.1: (12& 13) as one, 18
  - 16.2: 12, 14

[1]Hint: If $R^* = \langle a \rangle$, then for some $k \in \mathbb{Z}$, $1 = a^k$.

Course Calendar:

Wednesday	Monday
1/21 **1** Syllabus & ***Structures Overview Packet***	1/26 **2** ***Structures Overview Packet***
1/28 **3** Chapter 1	2/2 **4** Chapter 2
2/4 **5** Sections 3.1 & 3.2	2/9 **6** Sections 3.3
2/11 **7** Chapter 13	2/16 Presidents' Day - No Class
2/18 **8** ***Unit 1 Exam***	2/23 **9** Sections 4.1 - 4.4 and ***Unit 1 Assignment Due***
2/25 **10** ***Equivalence Relations Packet***	3/2 **11** ***Equivalence Relations Packet***
3/4 **12** Sections 5.1 & 5.2	3/9 **13** Sections 5.2 & 4.5
3/11 **14** Sections 6.1 & 6.2	3/16 Spring Break - No Class
3/18 Spring Break - No Class	3/23 **15** Sections 14.1 & 14.2
3/25 **16** Sections 14.2 & 14.3	3/30 **17** ***Unit 2 Exam***
4/1 **18** Sections 7.1 - 7.3 and ***Unit 2 Assignment Due***	4/6 **19** Sections 7.4

Wednesday	Monday
4/8 **20** Sections 7.5	4/13 **21** ***Unit 3 Exam***
4/15 **22** Sections 8.1 and ***Unit 3 Assignment Due***	4/20 **23** Sections 8.2 & 8.3
4/22 **24** Sections 8.3 & 8.4	4/27 **25** Sections 8.4 & 8.5
4/29 **26** Sections 16.1	5/4 **27** Sections 16.2
5/6 **28** Clean-Up/Make-Up Day if extra time is needed or there is a snow day.	5/11 **29** ***Unit 4 Exam, Period 2 – 11:00am – 1:30pm***

Please note that 3/24/2026 is the day when midterm grades are submitted, 4/13/2026 is the last day students can withdraw from a class, 5/8/2026 is the last day of classes, and 5/11/2026 through 5/15/2026 is final exam week. The ***Unit 4 Assignment*** is due by 3 pm on 5/15/2026

Departmental Outline:

1. Introduction to Rings and Fields
   (a) Rings of Integers and Integers Modulo n
   (b) Units Modulo n
   (c) Rational Numbers
   (d) Real Numbers
   (e) Extensions:
      i. Polynomial ring as extensions of a ring or field
      ii. Complex numbers as an extension of the Real Numbers
      iii. Extensions in general
   (f) Factorization:
      i. Unique factorization of integers
      ii. Unique factorization of polynomials
   (g) Subrings, Ideals and Quotient Rings:
      i. Subrings and Ideals
      ii. Integral Domains
      iii. Principle Ideal Domains
   (h) Ring and Field Morphisms:
      i. Linear transformations
      ii. Homomorphisms for rings and fields
      iii. Isomorphisms for rings and fields
2. Introduction to Groups
   (a) Geometric Transformations
   (b) Group Structures in Number Theory and Linear Algebra
   (c) Group Structures in Integer, Rational, Real, and Complex Numbers
   (d) Permutation Groups
   (e) Subgroups, Normal Subgroups, and Quotient Groups:
      i. Cosets
      ii. Lagrange's Theorem

End User Agreement:

General Expectations: As a student in this class you are expected to:

- attend class and take notes,
- actively read material in each section, taking notes,
- review your notes on a regular basis,
- check your university email every day,
- check the class site **at least** every other day,
- begin studying for exams in a timely fashion,
- ask questions early and often,
- attend office hours,
- seek help in the math clinic, and
- complete assignments and readings on time.

Assignment Guidelines: (These apply to **all out of class work** done on paper.)

- Work done outside of class must always look neat, legible, and professional, adhering to given guidelines. Work must be very neatly written or preferably typed. The quality of your work will be factored into your grade, up to 10%. In extreme cases work may be rejected and then counted as late.
- An assignment is considered late after I have handed it back or gone over it in class. Late assignments are accepted but may receive at most 75% credit. Late assignments go to the absolute bottom of the stack of papers to be graded; **all on time work is graded before any late work.**
- If you work on an assignment as part of a group, then there may be no more than three individuals in the group and all your names must be on the assignment. You should hand in only one copy of the work.
- All work must be submitted in the manner directed.

Email Etiquette Guidelines: When sending an email you must include the course number and semester in the subject line. For example, if you are taking MAT 314 in Fall 1592 then the the subject line should begin with "[MAT 314 Fall 1592]." Also, you should always begin with a salutation such as "Dear Dr. Rocca" and end with a closing such as "Sincerely, I. Newton."

Technology Use: You are free to use tablets, computers, or voice recorders in the classroom to support the learning of the content, i.e. for note taking, recording, taking pictures of the board etc.. ***Cell phones are not allowed as they are a consistent distraction***. Technology use will be further restricted if it becomes disruptive, a distraction, or invades others privacy.

Exam Makeup Policy: To qualify for a makeup exam you must have a valid reason for missing the exam and, if at all possible, let me know ahead of time that you are missing the exam. You will need to meet with me in order to arrange a time for a make up exam. If you do not have a valid reason, do not give prior notice when possible, or simply do not show up for an exam, you are not entitled to a makeup. If you fail to show up for your makeup exam, you will not be given a second opportunity.

Time on Task: As a 3 credit class you should expect to average 7.5 to 8.5 hours of work a week including class time. Some weeks you may get away with less and some may require more.

Attendance: Unless otherwise stated, there is no specific policy for attendance in this course. However, if you have **three consecutive unexcused absences** I am required to report to the University that you have **stopped attending**. Also, if you arrive late to class, after I have taken attendance, you are responsible for sending me an email to let me know you were there but late.

Academic Honesty: If on any assignment, quiz, or exam you turn in someone else's work, regardless of the source, as if it were your own you will receive a zero on that assignment, quiz, or exam. If you are caught doing this three times you will receive an F in the course and the Dean will be informed of your academic dishonesty.
(https://www.wcsu.edu/faculty-handbook/2019-2020/policies-pertaining-to-students/academic-honesty-policy/)

Accommodations: If you have need of an accommodation for testing or note taking, please visit AccessAbility Services, located in the HAAS Library room 406 (http://www.wcsu.edu/accessability).

You and Your Grades:

- "A" (Exceptional) range 90% to 100%:
  The student has demonstrated significant mastery of the appropriate knowledge and skills relevant to the course. The student is able to solve standard formulaic exercises and most nonstandard problems which require deeper insight.
- "B" (Good) range 80% to 90%:
  The student has demonstrated mastery of the appropriate knowledge and skills relevant to the course. The student is able to solve standard formulaic exercises and some nonstandard problems which require deeper insight.
- "C" (Adequate) range 70% to 80%:
  The student has demonstrated adequate mastery of the appropriate knowledge and skills relevant to the course. The student is able to solve most standard formulaic exercises but struggles with nonstandard problems which require deeper insight.
- "D" (Inadequate) range 60% to 70%:
  The student has demonstrated inadequate or incomplete mastery of the appropriate knowledge and skills relevant to the course. The student is able to solve some standard formulaic exercises but few if any nonstandard problems which require deeper insight.
- "F" (Unacceptable) below 60%:
  The student has demonstrated essentially no mastery of the appropriate knowledge and skills relevant to the course. The student is unable to solve most standard formulaic exercises and essentially no nonstandard problems which require deeper insight.

Inspire Your Professors:

What to do:

- Show up, on time, ready to learn.
- Ask, and try to answer, questions.
- Put in the time and do the scut work.
- Seek help when you need it, utilize the resources available to you.
- Be an active participant in class and in your own education.
- Be curious about everything and be here to learn.

What not to do:

- Don't ask "What is this good for?" or "Did I miss anything?" or "Does this have to be so hard?"
- Don't say "I don't get *it*."
- Don't fiddle with your phone or computer.
- Don't wander in late and rush out early.
- Don't disappear for extended periods of time in the middle of class.
- Try not to repeat questions that have just been asked and answered, sometimes multiple times.
- Don't just grub for points.
- Don't be a passive passenger to your own education.