

MTH 316: Algebra – Spring 2019

Department of Mathematics, University of Rhode Island

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Quick Details

Instructor: Dr. Michael Barrus

Office Location: 101C Lippitt Hall

Telephone: (401) 874-4430

Email: barrus@uri.edu

Office Hours: TWTh, 3 – 3:50 pm; other times by appointment

Class Days/Time: TuTh 11:00 am – 12:15 pm

Classroom: 205 Lippitt Hall

Prerequisites: MTH 215 and 307

Course Description

Theory and structure of groups. Topics from ring theory, principal ideal domains, unique factorization domains, polynomial rings, field extensions, and Galois theory. –2018-2019 URI Undergraduate & Graduate Catalog

Course Goals

Students will gain familiarity with fundamental structures and results of group theory through experience with problem solving and investigation. They will be able to justify basic facts about groups using mathematical proof.

Student Learning Outcomes

A more specific topical list of learning outcomes will be created throughout the semester and made available in Sakai. However, it is expected that upon successful completion of this course, each student will be able to do the following:

1. Define a group and give several different examples of groups; using the definition and fundamental results about groups, prove simple statements about groups.
2. Identify subgroups of a group and correctly use relevant terminology and notation.
3. Recognize and define cyclic groups; identify and count generators of cyclic groups and subgroups.
4. Define the permutation groups S_n and A_n ; use properties of permutations, such as order and parity, to answer questions about subgroups or elements.
5. Exhibit an isomorphism between two suitable groups or use invariant properties of groups to show that the groups are not isomorphic; use properties of isomorphisms and isomorphic groups to prove simple results; define and discuss the automorphism group and inner automorphism group of a group.
6. Compute the cosets of a subgroup of a given group; prove simple statements related to Lagrange's Theorem; use ideas of orbits and stabilizers to describe the action of a permutation group on a set.
7. Compute the external direct product of two groups; apply basic results about how external direct products relate to cyclic groups and U -groups.
8. Determine whether a given subgroup of a group is normal; given a normal subgroup H of a group G , compute the factor group G/H and perform operations within this group; use theorems resulting from applications of factor groups to answer questions about group properties.
9. Determine whether a map between two groups is a group homomorphism; use the First Isomorphism Theorem and related results to answer questions about groups and homomorphisms.

Required Text

Contemporary Abstract Algebra (9th edition) by Joseph A. Gallian.
Cengage Learning, ISBN: 978-1305657960

NOTE: Life will be much more convenient for you if you have your own copy of Gallian's text. Please make obtaining the use of one (whether through buying, renting, or long-term borrowing) an immediate priority; this is very important.

However, it is not necessary to have the most recent edition of the text. Earlier editions can be purchased much more cheaply, usually, than current editions (the downside is that newer editions can often be rented, while earlier editions must usually be purchased). Earlier editions will likely have mostly the same structure and basic content as the updated edition. With a little help from me (eg., referring to

section names, rather than page numbers, when discussing portions of the text, and providing you with typed lists of problems, rather than numbers of problems from the text), my hope is that you will be able to successfully and comfortably learn the course material using any edition of Gallian's text.

Classroom Protocol

Attendance and participation during class will be vital to the learning process, as classroom activities will be designed to provide needed practice and clarify misconceptions. No points will be attached to attendance in computing course grades, though attendance will be noted and may be used (at the instructor's discretion) in justifying an upward adjustment of a grade at the end of the semester.

Students are responsible for being familiar with and adhering to the published "Community Standards of Behavior: University Policies and Regulations" which can be accessed in the University Student Handbook. As with most university courses, all class participants are expected to behave in a respectful and safe manner at all times throughout the semester. Please do your best not to inhibit the learning experience of anyone else, and please feel free to bring any issues you have with others' behavior to the attention of the instructor. Issues that may arise will be dealt with in as respectful and confidential a manner as possible.

Grading Policy

Grades will be determined through a weighted average with categories and weights as follows:

- 20% Homework assignments
- 5% Groups wiki project
- 10% Group presentation
- 40% Midterm exams (2, equally weighted)
- 25% Final exam

Each grade category's components and policies will be described in sections that follow. No extra credit is anticipated for this course.

Letter grades for the course will be determined by considering your overall weighted percentage according to the scale on the next page:

A course percentage of at least	guarantees a letter grade of at least	A course percentage of at least	guarantees a letter grade of at least
93	A	77	C+
90	A-	73	C
87	B+	70	C-
83	B	67	D+
80	B-	60	D

A course percentage of less than 60% merits a grade of F.

Homework Assignments

Homework will be assigned approximately once a week (typically due on Thursday, though this may vary), for a total of roughly 11 assignments. Assignments may vary in content and format, depending on the current needs of the class, but both the details of the assignments and the deadlines will be announced in class and through Sakai. Unless otherwise specified, for full credit each assignment must be received by the end of class on the day it is due.

Solutions to all homework exercises must be clearly written with all necessary justification; a good write-up of your answer is just as important, usually, as a correct answer. Homework assignments will typically be graded as follows: most points will be awarded for one to three specific problems I will choose for grading in detail, and an additional number of points will be awarded based on completion of the rest of the problems.

I am happy to review your graded homework after it is passed back to you. Any requests for regrading (on either homework or exams) must be brought to my attention within 2 weeks of the item's return in class.

Late homework

Please respect the homework deadlines as much as possible and expect that I will strictly enforce the policy stated here. Each assignment's score will contribute roughly 2% of your overall course grade, and none of these scores will be dropped in calculating your course grade, so it is very important that you complete each assignment as correctly and as punctually as you can.

Late homework may be accepted for 90% if turned in up to one class period after it is due, and up to 80% of its original value up until 10 University class days after it is due, after which the maximum that can be earned is 50%. By University policy, homework may not be accepted after December 11 at the end of our last class meeting.

When assignments must be turned in late, you are encouraged to turn them in **as soon as possible**, even if it is not a class day. You may bring them to my

office, slipping them under my door if necessary, or at the Mathematics Department office suite in 200 Lippitt Hall. Alternatively, you may submit your assignments electronically by emailing them directly to me at barrus@uri.edu; in many cases this will allow you to turn late homework in sooner for a reduced penalty.

Group work

Group work can be a wonderful thing, and I encourage it. However, do not simply copy someone else's work verbatim or submit work that you do not understand; I consider this dishonest, and it is rarely beneficial to anyone's learning. Please seek help early (from me, a classmate, etc.), and when you do receive help from someone besides yourself, be sure to clearly acknowledge that help with a statement on your homework.

Group work is not allowed for any exam.

Groups Wiki Project

Beginning with our discussion of Chapter 2, class members will work together to flesh out a Sakai wiki about a set of sample groups presented to the class. Each student will be assigned a substantial contribution to the wiki (and notify the instructor while doing so) each week to earn full credit for the assignment. More details on the assignment and its assessment will be provided as the semester progresses.

Group Presentation

During the last week of class, each student will, as part of a group, give a presentation on an approved paper or topic related to group theory. Presentations should last between 10 and 20 minutes. A list of papers/topics to choose from and a detailed rubric for the assignment will be provided in Sakai by the date of the second midterm exam. Groups will consist of 2 to 3 students and may be self-selected or assigned by the instructor. To ensure fairness, grading for the assignment will include input from individual group members on each other's contributions.

Midterm Exams

There will be two midterm exams, given in class on the following dates:

- (1) Tuesday, February 26;
- (2) Tuesday, April 2.

Both exams will be held in our classroom during our usual class period. Each will be worth 20% of your course grade. While the primary focus of each midterm will be on the material covered since the previous exam, you are expected to retain important information from material tested on previous exams. No notes, texts, calculators, or aids of any kind will be allowed on any exam without written

instructions from the instructor. The best way to prepare for each exam will be to frequently test yourself on assigned homework exercises and the associated concepts, theorems, and learning outcomes (recorded in the learning outcomes document). More specific information will be given for each exam as it approaches.

Final Exam

The final exam will be comprehensive, though roughly half its content will focus on the material covered since the latter midterm exam. Unless otherwise suggested by the instructor and agreed upon unanimously by the class, the exam will be offered in our classroom at the University-appointed time, namely, **Thursday, May 2, from 8:00 to 11:00 am**. University policies concerning the final exam will be strictly adhered to. More information on the final will be given towards the end of the semester.

A Request

In an effort to improve my teaching in future semesters, I'd like to hold on to copies of some student work to use as examples for students in future semesters of this course and possibly related courses. For these purposes it is helpful to have both correct examples and incorrect ones. At times I may contact you (usually by email) asking if you will allow me to use copies of your submitted work, in an anonymous way, as part of an example in my future teaching. You will be free to ask questions and/or decline, and I will never directly use your work for these purposes without your consent. However, if you are willing to help me and future semesters of students in this way, I will gratefully and respectfully use your (anonymized) work to help me clearly and effectively show students how to learn this course's material. (And of course, if there are mistakes in your work, I'll do my best to help you overcome those, too, no matter whether you grant me permission to save it or not.)

Accommodations for Special Needs

Section 504 of the Rehabilitation act of 1973 and the Americans with Disabilities Act of 1990 require the University of Rhode Island to provide academic adjustments or the accommodations for students with documented disabilities. The student with a disability shall be responsible for self-identification to the Disability Services for Students in the Office of Student Life, providing appropriate documentation of disability, requesting accommodation in a timely manner, and follow-through regarding accommodations requested. It is the student's responsibility to make arrangements for any special needs and the instructor's responsibility to accommodate them with the assistance of the Office of Disability Services for Students.

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Disability Services for Students Office at 330 Memorial Union, 401-874-2098.

Academic Honesty

All submitted work must be your own. If you consult other sources (articles or books, including digital versions, resources belonging to other students from this or other universities/semesters, or online resources—including so-called “homework help” sites) these MUST be properly documented with a written comment on your assignment giving bibliographic information, or you will be charged with plagiarism/academic dishonesty and will receive a penalty for the assignment, up to and including a full loss of credit. In some cases, this may result in a failure of the course as well. In addition, the charge of academic dishonesty will go on your record in the Office of Student Life. If you have any doubt about what constitutes plagiarism, visit the URI Student Handbook and University Manual sections on Plagiarism and Cheating at <http://www.uri.edu/facsen/8.20-8.27.html>.

For example, academic dishonesty includes (but is not limited to) the following actions:

- Using material, directly or paraphrasing, from published sources (print or electronic) without appropriate citation
- Claiming disproportionate credit for work not done independently
- Unauthorized possession or access to exams
- Unauthorized communication during exams
- Unauthorized use of another’s work or preparing work for another student
- Taking an exam for another student
- Altering or attempting to alter grades
- The use of notes or electronic devices to gain an unauthorized advantage during exams
- Fabricating or falsifying facts, data or references
- Facilitating or aiding another’s academic dishonesty
- Submitting the same paper for more than one course without prior approval from the instructors.

If you are unsure about whether an action you have taken or are considering is academically honest, **please ask** (sooner, rather than later).

Inappropriate Use of Course Materials

All course materials (e.g., outlines, handouts, syllabi, exams, quizzes, slideshows/presentations, lectures, audio and video recordings, etc., whether in tangible or digital form) are proprietary unless otherwise indicated by an explicit license presented with the material. In order to preserve the value of course materials and the educational experiences of later students, and to maintain appropriate copyright status for instructor creations, students are prohibited from posting online or selling any such course materials without express written permission from the instructor.

Religious Holidays

It is the policy of the University of Rhode Island to accord students, on an individual basis, the opportunity to observe their traditional religious holidays. Students desiring to observe a holiday of special importance must provide written notification to each instructor.

MTH 316 Algebra, Spring 2019
Tentative Course Schedule

The following schedule is subject to change with fair notice to be given in class and through Sakai.

Course Schedule

Date	Topics, Readings, Important Dates
Jan. 24, 29	Preface to group theory (including Chapter 1: Introduction to Groups) <i>(Tues 1/29: Open add deadline)</i>
Jan. 31, Feb. 5	Chapter 2: Groups
Feb. 7, 12	Chapter 3: Finite Groups; Subgroups <i>(Wed 2/13: Deadline to drop with no transcript entry)</i>
Feb. 14, 19	Chapter 4: Cyclic Groups
Feb. 21, 26	Review / catch up Tuesday, February 26: Exam 1
Feb. 28, Mar. 5	Chapter 5: Permutation Groups <i>(Wed 3/6: Deadline to drop with transcript entry)</i>
Mar. 7, 19	Chapter 6: Isomorphisms <i>(Mon 3/11-Fri 3/15: Spring Break)</i>
Mar. 21, 26	Chapter 7: Cosets and Lagrange's Theorem
Mar. 28, Apr. 2	Review / catch up Tuesday, April 2: Exam 2
Apr. 4, 9	Chapter 8: External Direct Products
Apr. 11, 16	Chapter 9: Normal Subgroups and Factor Groups
Apr. 18, 23	Chapter 10: Group Homomorphisms Chapter 11: The Fundamental Theorem of Finite Abelian Groups
Apr. 25, 30	Group presentations
Thursday, May 2	Final Exam, 8:00 am - 11:00 am in Lippitt Hall Room 205 (our classroom)