MTH 316: Algebra
Spring 2016

University of Rhode Island

Instructor: Dr. Michael Barrus
Office Location: 101C Lippitt Hall
Telephone: (401) 874-4430
Email: barrus@uri.edu
Office Hours: Mon & Wed, 2 – 3:30 pm or by appointment
Class Days/Time: TuTh 12:30 – 1:45 pm
Classroom: 213 Morrill 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. – 2015-2016 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
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**


**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:

- 18% Homework assignments
- 2% Study strategies blog post
- 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 following scale:

<table>
<thead>
<tr>
<th>A course percentage of at least</th>
<th>A course guarantees a letter grade</th>
<th>A course percentage of at least</th>
<th>A course guarantees a letter grade</th>
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</thead>
<tbody>
<tr>
<td>93</td>
<td>A</td>
<td>77</td>
<td>C+</td>
</tr>
<tr>
<td>90</td>
<td>A-</td>
<td>73</td>
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<td>87</td>
<td>B+</td>
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<tr>
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<td>B</td>
<td>67</td>
<td>D+</td>
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<tr>
<td>80</td>
<td>B-</td>
<td>60</td>
<td>D</td>
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A course percentage of less than 60% merits a grade of F.

Homework assignments

Homework will be assigned approximately once a week (typically on Tuesday, though dates may vary), for a total of roughly 10 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 two to three specific problems I will choose for grading in detail, and an additional smaller 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**

Late homework may be accepted up until 10 class days after it is due, though the maximum possible percentage that may be earned will drop in increments of 10 percentage points for each class day or partial day between its deadline and submission. (For example, an assignment that is received the Monday after its Thursday due date will be graded normally but will have its score capped at 80% of the assignment’s possible value, assuming the University held classes on Friday.) Please respect the homework deadlines and expect that I will strictly enforce them. By University policy, homework may not be accepted after April 28 (our last class meeting).

**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.

**Study strategies blog post**

Many people find abstract algebra to be a challenging course, and with good reason—the abstraction and heavy reliance on definitions requires you to recall many facts and results and think very carefully in order to succeed.

In order to help you be conscientious about your own studies, each student will be assigned to compose a blog entry of between 150 and 500 words detailing a single strategy that they personally find effective in studying for class, or adding their own thoughts on a strategy previously introduced. The blog will be found within Sakai, and class members will sign up for a date on which they will post their blog entry (individual posts will be spread throughout the semester, in order to encourage continued reflection on your learning process). Credit will be assigned principally on contribution length and quality; more information on this assignment will be given, as needed, throughout the semester.

**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 four groups to study and must make at least
five substantial contributions to the wiki (and notify the instructor while doing so) 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 first 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) Thursday, February 25;
(2) Thursday, March 31.
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 and theorems. More specific information will be given for each exam as it approaches.

**Final exam**
The final exam will be comprehensive, though roughly 2/3 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 on **Thursday, May 5, from 11:30 to 2:30 pm**. 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.

**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](http://www.uri.edu/facsen/8.20-8.27.html).

For example, unless you receive instructor authorization in writing, you may not receive help on exams from any source, and if you receive help as you complete a homework assignment, you should acknowledge that help on your assignment. 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. 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.
The following schedule is subject to change with fair notice to be given in class and through Sakai.

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<th>Course Schedule</th>
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<tr>
<td><strong>Week</strong></td>
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| 2 | Feb. 2, 4 | Chapter 2: Groups  
*(Mon 2/1: Open add deadline)* |
| 3 | Feb. 9, 11 | Chapter 3: Finite Groups; Subgroups |
| 4 | Feb. 16, 18 | Chapter 4: Cyclic Groups  
*(Tues 2/16: Deadline to drop with no transcript entry)* |
| 5 | Feb. 23, 25 | Review / catch up  
**Thursday, February 25: Exam 1** |
| 6 | Mar. 1, 3 | Chapter 5: Permutation Groups |
| 7 | Mar. 8, 10 | Chapter 6: Isomorphisms  
*(Tues 3/8: Deadline to drop with transcript entry)* |
| 8 | Mar. 15, 17 | Chapter 7: Cosets and Lagrange’s Theorem |
| 9 | Mar. 29, 31 | Review / catch up  
**Thursday, March 31: Exam 2** |
| 10 | Apr. 5, 7 | Chapter 8: External Direct Products |
| 11 | Apr. 12, 14 | Chapter 9: Normal Subgroups and Factor Groups |
| 12 | Apr. 19, 21 | Chapter 10: Group Homomorphisms |
| 13 | Apr. 26, 28 | Group presentations  
Excerpts from Chapters 11 and 12 (Fundamental Theorem of Finite Abelian Groups; Introduction to Rings) |
| **Final Exam** | **Lippitt Hall Room 204 (our classroom)**  
**Thursday, May 5, 11:30 am - 2:30 pm** |