MATH 457: Abstract Algebra II  
Spring 2016

Class Meetings: MWF 3-4pm, Ford 201

Professor: Erin McNicholas  
Office: Ford Hall, Room 211  
email: emcnicho@willamette.edu  
Phone: 503-370-6590

Class Website: Course information, assignments, due dates, and policies are all available on the course website under WISE

Office Hours: will be posted on the course WISE site. In addition to the posted times, I am always available by appointment.

Class Objectives

“Abstraction consists essentially in the creation and utilization of ambiguity. Logic moves in one direction, the direction of clarity, coherence and structure. Ambiguity moves in the other direction, that of fluidity, openness, and release. Mathematics moves back and forth between these two poles. It is the interaction between these different aspects that gives mathematics its power.”  -William Byers

In this course, you will delve further into the abstract realm of Groups, Rings, and Fields. In particular you will examine extension fields, Galois Theory, Sylow Theorems, Representation Theory, and a host of other topics. You will continue to develop your mathematical maturity and independence by asking good questions and identifying underlying abstract patterns. You will hone your stellar proof-writing skills, and strengthen your mathematical presentation skills. Your grade will be based on your level of achievement in each of the following student learning outcomes:

- Your mathematical thinking\(^1\), proof reading, and proof writing
  As demonstrated on exams, homework sets, and your preparation for your in-class presentations

- Your presentation skills
  As demonstrated through in-class presentations of new content

- Your content knowledge
  As demonstrated on exams, homework sets, and in your presentations

- Your participation in the mathematical community and your exposure to mathematical research
  As demonstrated by your attendance of mathematics colloquia and your collaboration with your peers

\(^1\)including your ability to abstract, combine creative and algebraic approaches to problem-solving, and your ability to formulate conjectures.
Required Course Materials:

Contemporary Abstract Algebra, 8th ed. by Joseph Gallian

Course Components

Exams (Total of 350 points): There will be three group exams, each worth 50 points. For more information on group exams, see the Group Exam link on the class WISE site. There will be one midterm and one cumulative final, each worth 100 points.

2 Presentations (150 points each): Working in groups of three, you will present two sections of material during the course. Each section will take two days to present. Presentation grades will be based on thoroughness, clarity, and style, and will be out of 100 points. In addition to your presentation, you will LaTeX a five to six problem quiz and key to accompany the material you’re presenting. The quiz, but not the key will be distributed to the class. The quiz will be graded on a 50 point scale based on appropriateness, how well it covers the material, and accuracy of the key. Quizzes are due two class periods before your first presentation day.

Homework (80 points): Homework will be assigned on a weekly basis. Solutions must be LaTeXed.

Mathematical Development (20 points): Students are expected to attend 4 of the Math Colloquium Talks given throughout the semester. These talks will be announced in class and a schedule can be found on the Math Department web site: [http://www.willamette.edu/cla/math/news/colloquia/index.html](http://www.willamette.edu/cla/math/news/colloquia/index.html) An excellent essay on how to approach math colloquium talks is available here: [http://www.willamette.edu/~emcnicho/courses/Multi249/How_to_listen_to_a_Math_Lecture_Korner.pdf](http://www.willamette.edu/~emcnicho/courses/Multi249/How_to_listen_to_a_Math_Lecture_Korner.pdf). The goal of this attendance requirement is to introduce students to the diversity and vitality of current mathematics research, and to include them in the Math Department culture.

Grades: Course grades will be based on the percentage of possible points you earn. Grade cut-offs will be determined at the end of the semester. 90% and above will guarantee you an A-, 80% and above a B-, and 70% and above a C-.

Student Responsibility:

You are all adults and responsible for your own education. I will do everything in my power to help you learn. You should always feel free to stop by my office or make an appointment to meet with me. You should also feel free to ask me questions in class. Stop me if you are confused and ask me to explain things again. I welcome student questions! Although I will do everything in my power to help you through this class, you are ultimately responsible for your grade. The following is a list of things I expect from you.

- **READ THE TEXTBOOK.** Your textbook was chosen for its readability. It is an excellent resource for cementing the concepts we go over in-class.
- **DO THE ASSIGNMENTS.** Mathematics is not a spectator sport. You will only learn mathematics by practicing, that is what homework is for. I encourage you to work with your fellow students on homework assignments. Make it a social activity and you will have fun doing it. However, your LaTeX write-ups must be your own. While you are welcome to outline solutions together, and discuss approaches, there should be no file sharing, and your final write-ups should be your own.
- **THINK CRITICALLY.** Your goal in this class should be to understand the concepts and strengthen your mathematical reasoning, proof writing, and presentation skills. Throughout the course you should be asking yourself “Why are we doing this? Why does this method work? How is this related to other topics I’ve learned? How would this apply to a concrete example?”
• **ASK QUESTIONS & SEEK HELP!** Ask questions in class, after class, during office hours, whenever! If you are confused or having problems with a certain section of the material see me AS SOON AS POSSIBLE. I am happy to help you but it is impossible to go over several weeks worth of material right before an exam.

• **STUDY.** The standard rule of thumb is that you should spend *three hours outside of class on course work for each hour spent in class.* To master the content of this course and to earn a good grade you will need to invest time and effort. Set aside time for both homework and studying.

**Late Assignments and Missed Classes:**

I expect everyone to attend all classes and turn in all assignments. If for some reason you are unable to attend class or turn in an assignment, please let me know as soon as possible, preferably before the missed class or assignment. You should contact me prior to missing an exam. In most cases, if you have a valid excuse, the grade on the final will be used to replace your missed exam score.

**Cell Phone/Screen Policy**

Unless specifically stated for class use, no laptops, iPads, or other devices which take your eyes off your fellow classmates and the class discussion are allowed. Electronic devices such as cell phones, pagers, iPods, etc. must be turned off during class meetings. *If your cell phone goes off, or it is clear that you are using one of these devices during class, you will be responsible for bringing treats for the entire class at the next class meeting.***

**Academic Integrity**

As is stated in the Willamette University CLA catalog

“Plagiarism and cheating are offenses against the integrity of the courses in which they occur and against the college community as a whole. Plagiarism and cheating involve intellectual dishonesty, deception and fraud, which inhibit the honest exchange of ideas. In accordance with Willamette University Standards of Conduct and the Willamette Ethic, students are entitled to notice of what constitutes plagiarism and cheating, and the right to appeal penalties. Plagiarism and cheating may be grounds for dismissal from the college.”

Additional information can be found on the Plagiarism and Cheating Policy website
http://www.willamette.edu/cla/catalog/resources/policies/
<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Info &amp; Ch 20</th>
<th>Ch 20</th>
<th>MLK</th>
<th>Ch 21</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/18-1/22</td>
<td>Ch 20 EM</td>
<td>Ch 20</td>
<td>EM</td>
<td>No Class</td>
</tr>
<tr>
<td>2</td>
<td>1/25-1/29</td>
<td>Ch 20 EM</td>
<td>Ch 20</td>
<td>EM</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2/1-2/5</td>
<td>Ch 21 Group 0</td>
<td>Ch 21</td>
<td>Group 0 Quiz due</td>
<td>Group Exam 1</td>
</tr>
<tr>
<td>4</td>
<td>2/8-2/12</td>
<td>Ch 32 EM</td>
<td>Ch 32</td>
<td>EM</td>
<td>Group 1 Quiz due</td>
</tr>
<tr>
<td>5</td>
<td>2/15-2/19</td>
<td>Ch 22-23 Group 1</td>
<td>Ch 22-23</td>
<td>Group 1</td>
<td>Ch 24</td>
</tr>
<tr>
<td>6</td>
<td>2/22-2/26</td>
<td>Ch 24 EM</td>
<td>Ch 24</td>
<td>Group 2 Quiz due</td>
<td>Ch 25 EM Exam</td>
</tr>
<tr>
<td>7</td>
<td>2/29-3/4</td>
<td>Ch 26 Group 2</td>
<td>Ch 26</td>
<td>Group 2</td>
<td>Ch 27-28 Group 3 Group 4 Quiz due</td>
</tr>
<tr>
<td>8</td>
<td>3/7-3/11</td>
<td>Ch 27-28 Group 3</td>
<td>Ch 29</td>
<td>Group 4 Group 5 Quiz due</td>
<td>Ch 29 Group 4</td>
</tr>
<tr>
<td>9</td>
<td>3/14-3/18</td>
<td>Ch 30 Group 5</td>
<td>Ch 30</td>
<td>Group 5</td>
<td>Group Exam 2</td>
</tr>
<tr>
<td>10</td>
<td>3/21-3/25</td>
<td></td>
<td></td>
<td></td>
<td>Spring Break</td>
</tr>
<tr>
<td>11</td>
<td>3/28-4/1</td>
<td>Ch 31 Group 6</td>
<td>Ch 31</td>
<td>Group 6</td>
<td>Ch 33 Group 7 Group 8 Quiz due</td>
</tr>
<tr>
<td>12</td>
<td>4/4-4/8</td>
<td>Ch 33 Group 7</td>
<td>Products</td>
<td>Group 8 Products Group 8</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>4/11-4/15</td>
<td>Modules Group 9</td>
<td>Module</td>
<td>Group 9</td>
<td>Group Exam 3</td>
</tr>
<tr>
<td>16</td>
<td>5/2</td>
<td>Category Theory Group 12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The following schedule is subject to change.
Tentative Schedule

The following schedule is subject to change.

<table>
<thead>
<tr>
<th>Day</th>
<th>Class Activities &amp; Discussions</th>
<th>Deadlines</th>
</tr>
</thead>
<tbody>
<tr>
<td>M (1/18)</td>
<td>Syllabus &amp; Ch 20</td>
<td></td>
</tr>
<tr>
<td>W (1/20)</td>
<td>Ch 20 Extension Fields</td>
<td></td>
</tr>
<tr>
<td>F (1/22)</td>
<td>Martin Luther King Observance, No Class</td>
<td></td>
</tr>
<tr>
<td>M (1/25)</td>
<td>Ch 20 Ext Fields</td>
<td></td>
</tr>
<tr>
<td>W (1/27)</td>
<td>Ch 20 Ext Fields</td>
<td></td>
</tr>
<tr>
<td>F (1/29)</td>
<td>Ch 21 Alg &amp; Transc Ext</td>
<td></td>
</tr>
<tr>
<td>M (2/1)</td>
<td>Ch 21 Alg &amp; Transc Ext</td>
<td>A/D Deadline</td>
</tr>
<tr>
<td>W (2/3)</td>
<td>Ch 21 Alg &amp; Transc Ext</td>
<td></td>
</tr>
<tr>
<td>F (2/5)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M (2/8)</td>
<td>Ch 32 Galois Theory</td>
<td></td>
</tr>
<tr>
<td>W (2/10)</td>
<td>Ch 32 Galois Theory</td>
<td></td>
</tr>
<tr>
<td>F (2/12)</td>
<td>Ch 32 Galois Theory</td>
<td></td>
</tr>
<tr>
<td>M (2/15)</td>
<td>Ch 22-23 FFs &amp; Geo Constructs</td>
<td></td>
</tr>
<tr>
<td>W (2/17)</td>
<td>Ch 22-23 FFs &amp; Geo Constructs</td>
<td></td>
</tr>
<tr>
<td>F (2/19)</td>
<td>Ch 24 Sylow Thms</td>
<td></td>
</tr>
<tr>
<td>M (2/22)</td>
<td>Ch 24 Sylow Thms</td>
<td></td>
</tr>
<tr>
<td>W (2/24)</td>
<td>Ch 24 Sylow Thms</td>
<td></td>
</tr>
<tr>
<td>F (2/26)</td>
<td>Ch 25 Finite Simple Grps</td>
<td></td>
</tr>
<tr>
<td>M (2/29)</td>
<td>Ch 26 Generators &amp; Relns</td>
<td></td>
</tr>
<tr>
<td>W (3/2)</td>
<td>Ch 26 Generators &amp; Relns</td>
<td></td>
</tr>
<tr>
<td>F (3/4)</td>
<td>Ch 27-28 Symmetry Groups</td>
<td></td>
</tr>
<tr>
<td>M (3/7)</td>
<td>Ch 27-28 Symmetry Groups</td>
<td></td>
</tr>
<tr>
<td>W (3/9)</td>
<td>Ch 29 Symmetry &amp; Counting</td>
<td></td>
</tr>
<tr>
<td>F (3/11)</td>
<td>Ch 29 Symmetry &amp; Counting</td>
<td></td>
</tr>
<tr>
<td>M (3/14)</td>
<td>Ch 30 Cayley Digraphs</td>
<td></td>
</tr>
<tr>
<td>W (3/16)</td>
<td>Ch 30 Cayley Digraphs</td>
<td></td>
</tr>
<tr>
<td>F (3/18)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(3/21-3/25)</td>
<td>Spring Break - No Classes</td>
<td></td>
</tr>
<tr>
<td>M (3/28)</td>
<td>Ch 31 Alg Coding Theory</td>
<td></td>
</tr>
<tr>
<td>W (3/30)</td>
<td>Ch 31 Alg Coding Theory</td>
<td></td>
</tr>
<tr>
<td>F (4/1)</td>
<td>Ch 33 Cyclotomic Exts</td>
<td></td>
</tr>
<tr>
<td>M (4/4)</td>
<td>Ch 33 Cyclotomic Exts</td>
<td></td>
</tr>
<tr>
<td>W (4/6)</td>
<td>Simidirect &amp; Wreath Products</td>
<td></td>
</tr>
<tr>
<td>F (4/8)</td>
<td>Simidirect &amp; Wreath Products</td>
<td></td>
</tr>
<tr>
<td>M (4/11)</td>
<td>Modules</td>
<td></td>
</tr>
<tr>
<td>W (4/13)</td>
<td>Modules</td>
<td></td>
</tr>
<tr>
<td>F (4/15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M (4/18)</td>
<td>Rep Theory</td>
<td></td>
</tr>
<tr>
<td>W (4/20)</td>
<td>SSRD - No Classes</td>
<td></td>
</tr>
<tr>
<td>F (4/22)</td>
<td>Rep Theory</td>
<td></td>
</tr>
<tr>
<td>M (4/25)</td>
<td>Homological Alg (or alt)</td>
<td></td>
</tr>
<tr>
<td>W (4/27)</td>
<td>Homological Alg (or alt)</td>
<td></td>
</tr>
<tr>
<td>F (4/29)</td>
<td>Category Theory</td>
<td></td>
</tr>
<tr>
<td>M (5/2)</td>
<td>Category Theory</td>
<td></td>
</tr>
<tr>
<td>W (5/11)</td>
<td>Final, 2-5pm</td>
<td></td>
</tr>
</tbody>
</table>