**POINT LOMA**
**NAZARENE UNIVERSITY**

Mathematics, Information, and Computer Sciences – School of STEM
MTH 4044- Abstract Algebra
4 units
Fall 2024
Monday, Wednesday and Friday  – 1:30 pm – 2:35 pm
**Rohr Science, room 295**
Final Exam: Wednesday December 18th 1:30 pm – 4:00 pm

| Information | Specifics for the course |
|---|---|
| Instructor name and title: | Catherine Crockett, Professor of Mathematics |
| Phone: | 619-849-2627 |
| Email: | catherinecrockett@pointloma.edu |
| Office location and hours: | Rohr Science 222 or ZOOM |
| | Mondays, Wednesdays and Fridays 11:00 am – 12:00 pm |
| | Tuesdays and Thursdays 10:00 to 11:30 |
| | Tuesdays 3:00 to 4:00 |
| | Fridays 2:40 to 3:30 |
| | or by appointment |

**PLNU MISSION: TO TEACH ~ TO SHAPE ~ TO SEND**
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

**DEPARTMENT MISSION**
The Mathematical, Information, and Computer Sciences department at Point Loma Nazarene University is committed to maintaining a curriculum that provides its students with the tools to be productive, the passion to continue learning, and Christian perspectives to provide a basis for making sound value judgments.

**COURSE DESCRIPTION**

**MTH 4044 – Abstract Algebra**

A Study of groups, rings, fields and related structures with selected applications.
Corequisites: MTH 2033 and MTH 3012 and Junior Standing

**PROGRAM AND COURSE LEARNING OUTCOMES**

1. Students will be able to write proofs.
2. Students will be able to demonstrate facility with algebraic structures.
3. Students will be able to speak about their work with precision, clarity and organization.
4. Students will be able to write about their work with precision, clarity and organization.
5. Students will collaborate effectively in teams.
6. Students will be able to understand and create arguments supported by quantitative evidence, and they can clearly communicate those arguments in a variety of formats.

**REQUIRED TEXTS AND RECOMMENDED STUDY RESOURCES**

*A First Course in Abstract Algebra*, 7th edition, by John B. Fraleigh (ISBN: 9780201763904)

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**COURSE CREDIT HOUR INFORMATION**

In the interest of providing sufficient time to accomplish the stated Course Learning Outcomes, this class meets the PLNU credit hour policy for a 4 -unit class delivered over 15 weeks. It is anticipated that students will spend a minimum of 37.5 participation hours per credit hour on their coursework.

**ASSESMENT AND GRADING**

The grade components are written homework, quizzes, midterm exams, and the final examination.

**Homework:** Homework will be assigned every class meeting. All homework assigned in a week will be due at the beginning of Wednesday's class of the following week. No late homework will be accepted except by prior (meaning more than 24 hours before) arrangement (with me) or with a documented emergency.

**Comments on homework:**

- This is the minimum amount of homework that is required but you may need to do several odd numbered problems to make sure you get the answer in the textbook.
- Please be sure that your homework is stapled together, and the problems are in order.
- **Homework will be scored on a combination of completeness and correctness. All work necessary to complete a problem must be shown to earn credit.**
- Start working on your homework early. These problems are difficult and meant to be done a little at a time over the course of a few days.
- When doing homework, please note it is normal to not be able to do every problem correct on the first attempt. Do not be discouraged, instead seek help.
- The two lowest homework scores will be dropped before calculating the overall grade for homework.

**Quizzes**:  There's a fair amount of evidence that regular quizzing (hence recall) is beneficial for the learning of new material.  Abstract Algebra is familiar concepts in and unfamiliar setting. There is a lot of vocabulary, definitions and knowledge of counterexamples that are needed to make progress in this course. The quizzes will focus on these areas. Quiz content will be announced in class ahead of time. This is an opportunity for informal assessment of your progress in the course.

**Examinations and the Final Examination:** There are three exams and one final exam. The exams will include problems and questions over material assigned in the text, readings, and handouts, as well as material presented in class.  If you do not take an exam, you will receive a zero for it.  Late exams may be taken only by prior arrangement with me or a well-documented emergency beyond your control. The

examination schedule is included in the daily schedule. Please note I do not intend to accept excuses such as poor communication with parents, benefactors, sport team sponsors and/or travel agents.

**GRADING SCALE**
A passing grade requires getting at least 60% in one of the two tests or on the final exam. Grades are based on the number of points accumulated throughout the course. Approximate minimal percentages required to obtain a given grade are:

| Grading Scale in Percentages | | | | |
|---|---|---|---|---|
| | A | B | C | D |
| + | | (87.5, 90] | (77.5, 80] | (67.5, 70] |
| | (92.5, 100] | (82.5, 87.5] | (72.5, 77.5] | (62.5, 67.5] |
| − | (90, 92.5] | (80, 82.5] | (70, 72.5] | [60, 62.5] |

**GRADING DISTRIBUTION**

| Grade Distribution | |
|---|---|
| Three Exams scored at 15% each | 45% |
| Final Exam (Cumulative) | 25% |
| Quizzes | 10% |
| Homework | 20% |
| Total | 100% |

**FINAL EXAMINATION POLICY**
Successful completion of this class requires taking the final examination on its scheduled day. The final examination schedule is posted on the Traditional Undergraduate Records: Final Exam Schedules site. If you find yourself scheduled for three (3) or more final examinations on the same day, you are authorized to contact each professor to arrange a different time for one of those exams. However, unless you have three (3) or more exams on the same day, no requests for alternative final examinations will be granted.

**INCOMPLETE AND LATE ASSIGNMENTS**
- All assignments are to be submitted/turned in by the beginning of the class session when they are due—including assignments posted in Canvas. Late work need not be accepted. Make-up tests will be given only by prior arrangement with the instructor for reasons of documented emergency.
- **Incomplete grade:** Incompletes will only be assigned in extremely unusual circumstances. You may request a grade of I (incomplete) only if you are having a passing grade and at least 70% of the course work is completed.

**SPIRITUAL CARE**
Please be aware PLNU strives to be a place where you grow as whole persons. To this end, we provide resources for our students to encounter God and grow in their Christian faith.
 If you have questions, a desire to meet with the chaplain or have prayer requests you can contact the Office of Spiritual Life and Formation

**STATE AUTHORIZATION**
State authorization is a formal determination by a state that Point Loma Nazarene University is approved to conduct activities regulated by that state. In certain states outside California, Point Loma Nazarene University is not authorized to enroll online (distance education) students.  If a student moves to another state after admission to the program and/or enrollment in an online course, continuation within the program and/or course will depend on whether Point Loma Nazarene University is authorized to offer distance education courses in that

state.  It is the student's responsibility to notify the institution of any change in his or her physical location.  Refer to the map on State Authorization to view which states allow online (distance education) outside of California.

**PLNU COPYRIGHT POLICY**
Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.

**PLNU RECORDING NOTIFICATION**
In order to enhance the learning experience, please be advised that this course may be recorded by the professor for educational purposes, and access to these recordings will be limited to enrolled students and authorized personnel.
Note that all recordings are subject to copyright protection. Any unauthorized distribution or publication of these recordings without written approval from the University (refer to the Dean) is strictly prohibited.

**PLNU ACADEMIC HONESTY POLICY**
Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when in reality they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. For all student appeals, faculty and students should follow the procedures outlined in the University Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

**ARTIFICIAL INTELLEGENCE (AI) POLICY**
You are allowed to use Artificial Intelligence (AI) tools (e.g., ChatGPT, Gemini Pro 1.5, GrammarlyGo, Perplexity, etc) to generate ideas, but you are not allowed to use AI tools to generate content (text, video, audio, images) that will end up in any work submitted to be graded for this course. If you have any doubts about using AI, please gain permission from the instructor.

**PLNU ACADEMIC ACCOMMODATIONS POLICY**
PLNU is committed to providing equal opportunity for participation in all its programs, services, and activities in accordance with the Americans with Disabilities Act (ADA). Students with disabilities may request course-related accommodations by contacting the Educational Access Center (EAC), located in the Bond Academic Center (EAC@pointloma.edu or 619-849-2486). Once a student's eligibility for an accommodation has been determined, the EAC will work with the student to create an Accommodation Plan (AP) that outlines allowed accommodations. The EAC makes accommodations available to professors at the student's request.
PLNU highly recommends that students speak with their professors during the first two weeks of each semester/term about the implementation of their AP in that particular course.  Accommodations are not retroactive so clarifying with the professor at the outset is one of the best ways to promote positive academic outcomes.

Students who need accommodations for a disability should contact the EAC as early as possible (i.e., ideally before the beginning of the semester) to assure appropriate accommodations can be provided. It is the student's responsibility to make the first contact with the EAC. Students cannot assume that because they had accommodations in the past, their eligibility at PLNU is automatic. All determinations at PLNU must go through the EAC process. This is to protect the privacy of students with disabilities who may not want to disclose this information and are not asking for any special accommodations.

**LANGUAGE OF BELONGING**
Point Loma Nazarene University faculty are committed to helping create a safe and hospitable learning environment for all students. As Christian scholars we are keenly aware of the power of language and believe in

treating others with dignity. As such, it is important that our language be equitable, inclusive, and prejudice free. Inclusive/Bias-free language is the standard outlined by all major academic style guides, including MLA, APA, and Chicago, and it is the expected norm in university-level work. Good writing and speaking do not use unsubstantiated or irrelevant generalizations about personal qualities such as age, disability, economic class, ethnicity, marital status, parentage, political or religious beliefs, race, gender, sex, or sexual orientation. Inclusive language also avoids using stereotypes or terminology that demeans persons or groups based on age, disability, class, ethnicity, gender, race, language, or national origin. Respectful use of language is particularly important when referring to those outside of the religious and lifestyle commitments of those in the PLNU community. By working toward precision and clarity of language, we mark ourselves as serious and respectful scholars, and we model the Christ-like quality of hospitality.

If you (or someone you know) have experienced a bias incident regarding language, you can find more information on reporting and resources at www.pointloma.edu/bias.

**SEXUAL MISCONDUCT AND DISCRIMINATION**
In support of a safe learning environment, if you (or someone you know) have experienced any form of sexual discrimination or misconduct, including sexual assault, dating or domestic violence, or stalking, know that accommodations and resources are available through the Title IX Office at pointloma.edu/Title-IX. Please be aware that under Title IX of the Education Amendments of 1972, faculty and staff are required to disclose information about such misconduct to the Title IX Office.
If you wish to speak to a confidential employee who does not have this reporting responsibility, you can contact Counseling Services at counselingservices@pointloma.edu or find a list of campus pastors at pointloma.edu/title-ix.
If you (or someone you know) have experienced other forms of discrimination or bias, you can find more information on reporting and resources at www.pointloma.edu/bias

**PLNU ATTENDANCE AND PARTICIPATION POLICY**
Regular and punctual attendance at all class sessions is considered essential to optimum academic achievement. If the student is absent for more than 10 percent of class sessions, the faculty member will issue a written warning of de-enrollment. If the absences exceed 20 percent, the student may be de-enrolled without notice until the university withdrawal date or, after that date, receive an "F" grade.

**CLASS ENROLLMENT**
It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

DAILY SCHEDULE

| Week | Monday | Wednesday | Friday |
|---|---|---|---|
| 1 | 9/2<br>Labor Day<br>No class | 9/4<br>Introduction to class<br>Sec. 0: Sets & Relations<br>Sec. 1: Introduction &<br>Examples | 9/6<br>Sec. 1: Introduction &<br>Examples<br>Sec. 2: Binary Operations |
| 2 | 9/9<br>Sec. 2: Binary Operations<br>Sec. 3: Isomorphic Binary<br>Structures | 9/11<br>Sec. 4: Groups<br>Homework #1 | 9/13<br>Sec. 5: Subgroups<br>Quiz #1 |
| 3 | 9/16<br>Sec. 6: Cyclic Groups | 9/18<br>Sec. 6: Cyclic Groups<br>Sec. 7: Generating Sets and<br>Cayley Digraphs<br>Homework #2 | 9/20<br>Sec. 8: Groups of<br>Permutations<br>Quiz #2 |
| 4 | 9/23<br>Review for Exam #1 | 9/25<br>Exam #1<br>Homework #3 | 9/27<br>Sec. 8: Groups of<br>Permutations<br>Sec. 9: Orbits, Cycles, and<br>Alternating Groups |
| 5 | 9/30<br>Sec. 9: Orbits, Cycles, and<br>Alternating Groups<br>Sec. 10: Cosets and the<br>Theorem of Lagrange | 10/2<br>Sec. 10: Cosets and the<br>Theorem of Lagrange<br>Sec. 11: Direct Products and<br>Finitely Generated Abelian<br>Groups<br><br>Homework #4 | 10/4<br>Sec. 11: Direct Products and<br>Finitely Generated Abelian<br>Groups<br><br>Quiz #3 |
| 6 | 10/7<br>Sec. 13: Homomorphisms | 10/9<br>Sec. 13: Homomorphisms<br>Sec. 14: Factor Groups<br><br>Homework #5 | 10/11<br>Sec. 14: Factor Groups<br>Quiz #4 |
| 7 | 10/14<br>Sec. 15: Factor-Group<br>Computations and Simple<br>Groups | 10/16<br>Sec. 15: Factor-Group<br>Computations and Simple<br>Groups<br>Homework #6 | 10/18<br>Sec. 18: Rings and Fields<br>Quiz #5 |
| 8 | 10/21<br>Review for Exam #2 | 10/23<br>Exam #2<br>Homework #7 | 10/25<br>No class<br>Fall Break |
| 9 | 10/28<br>Sec. 18: Rings and Fields<br>Sec. 19: Integral Domains | 10/30<br>Sec. 19: Integral Domains<br>Sec. 20: Fermat's and Euler's<br>Theorems | 11/1<br>Sec. 20: Fermat's and Euler's<br>Theorems<br>Quiz #6 |
| 10 | 11/4<br>Sec. 21: The Fields of<br>Quotients of an Integral<br>Domain | 11/6<br>Sec. 21: The Fields of<br>Quotients of an Integral<br>Domain | 11/8<br>Sec. 22: Rings of Polynomials<br>Quiz #7 |

| | | Sec. 22: Rings of Polynomials Homework #8 | |
|---|---|---|---|
| 11 | 11/11 Sec. 23: Factorization of Polynomials over a Field | 11/13 Sec. 23: Factorization of Polynomials over a Field Homework #9 | 11/15 Sec. 26: Homomorphisms and Factor Rings Quiz #8 |
| 12 | 11/18 Sec. 27: Prime and Maximal Ideals | 11/20 Sec. 27: Prime and Maximal Ideals | 11/22 Review for Exam #3 |
| 13 | 11/25 Exam #3 Homework #10 | 11/27 No class Thanksgiving | 11/29 No class Thanksgiving |
| 14 | 12/2 Sec. 29: Introduction to Extension Fields | 12/4 Sec. 29: Introduction to Extension Fields Sec. 30: Vector Spaces Homework #11 | 12/6 Sec. 30: Vector Spaces Sec. 31: Algebraic Extensions Quiz #9 |
| 15 | 12/9 Sec. 31: Algebraic Extensions Sec. 33: Finite Fields | 12/11 Sec. 33: Finite Fields Homework #12 | 12/13 Review for Final Exam |
| Finals | 12/16 | 12/18 Final 1:30 – 4:00 Homework #13 | 12/20 |