MATH 3312: Abstract Algebra II

Term: Spring 2025
Time and Place: Mondays & Wednesdays, 10:00am – 11:15pm in FN 2.106
Instructor: Dr. Carlos Arreche – arreche@utdallas.edu
Office: FO 2.408D
Office hours: Thursdays 10:00am – 12:00pm, or by appointment.

Suggested textbooks and materials:

- Abstract Algebra: Theory and Applications, 2022 edition, by Thomas W. Judson
- *A First Course in Abstract Algebra*, 7th edition, (2002), by John Fraleigh
- *How to Think About Abstract Algebra*, (2021), by Laura Alcock

Pre-requisites: MATH 3311.

Course description: This course is intended as a second course in abstract algebra for undergraduate math majors. Topics to be covered include a review of group theory, group actions, solvable groups, Sylow theorems, a review of ring theory, polynomial rings, unique factorization domains, principal ideal domains, Euclidean domains, algebraic and transcendental field extensions, splitting fields, finite fields, and elements of Galois theory.

Student Learning Objectives and Outcomes

1. Articulate fundamental concepts and theorems of group theory and ring theory.
2. Explain main definitions and results of group actions and apply them in examples.
3. Apply the Sylow theorems to prove solvability.
4. Explain the notions of unique factorization domain, principal ideal domain, and Euclidean domains, and how they are related.
5. Articulate basic elements related to Galois theory: polynomials and field extensions.

Expectations: It is a basic expectation of all students that they will attend all lectures, and that they will regularly and actively participate in the course by asking and responding to questions during class, office hours, and/or email.

Homework: Homework assignments will be posted on eLearning and are due every Friday that school is in session. Every assignment should be completed independently by each student; however, students are encouraged to collaborate in thinking through the homework assignments, so long as they provide the names of their collaborators. Homeworks will collectively account for 40% of the course grade. Late homeworks will not be accepted, except in case of extenuating circumstances that are communicated promptly to the instructor.

Exams: There will be two exams. Each exam will account for 30% of the course grade. Both exams are closed-book and closed-notes.

Grade Components: Students must show all details of their work to receive full credit.

- Homeworks: 40%
- Exam I: 30%
- Exam II: 30%

Grading Scale:

$[97-100] \to A+$	$[93-97) \to A$	$[90-93) \to A-$
$[87-90) \to B+$	$[83-87) \to B$	$[80-83) \to B-$
$[77-80) \to C+$	$[73-77) \to C$	$[70-73) \to C-$
$[67-70) \to D+$	$[63-67) \to D$	$[60-63) \to D-$
$[0-60) \to F$		

Important dates:

Tuesday, January 21 19: Classes begin
Wednesday, February 5: Census Day (last day to drop without a W)
Wednesday, March 12: Exam I
Monday, March 17 – Sunday, March 23: No classes; Spring Break
Wednesday, April 9: Withdrawal period ends
Friday, May 9: Last day of classes
Monday, May 12 – Friday, May 16: Final exams (Exam II will be on one of these days: exact date to be announced by the Registrar)

Tentative Schedule:

Monday	Wednesday
Jan 20th University closed: Martin Luther King Jr. Day	22nd **1** **Fraleigh: I.1, I.4, I.5.** **Judson: 3.2, 3.3.** Review of group theory: definitions & examples.
27th **2** **Fraleigh: II.10.** **Judson: 6.1, 6.2.** Cosets and Lagrange's Theorem.	29th **3** **Fraleigh: III.13, III.14, III.15.** **Judson: 11.2.** Homomorphisms and quotients.
Feb 3rd **4** **Fraleigh: VII.34.** **Judson: 10.1, 11.1.** Isomorphism theorems.	5th **5** **Fraleigh: II.9, II.12.** **Judson: 12.1, 12.2.** First examples of groups as symmetries.
10th **6** **Fraleigh: III.16.** **Judson: 14.1.** Group actions.	12th **7** **Fraleigh: III.17.** **Judson: 14.2, 14.3.** Burnside's formula and the class equation.
17th **8** **Fraleigh: III.17.** **Judson: 14.3.** Applications of group actions.	19th **9** **Fraleigh: II.11.** **Judson: 13.1.** Finitely generated abelian groups.
24th **10** **Fraleigh: VII.35.** **Judson: 13.2.** Series of groups & solvable groups.	26th **11** **Fraleigh: VII.36.** **Judson: 15.1, 15.2.** Sylow Theorems: preliminaries and statements.
Mar 3rd **12** **Fraleigh: VII.36.** **Judson: 15.1.** Sylow Theorems: proofs.	5th **13** **Fraleigh: VII.37.** **Judson: 15.2.** Applications of Sylow Theory (1 of 2).

Monday	Wednesday
10th **14** **Fraleigh: VII.37.** **Judson: 15.2.** Applications of Sylow Theory (2 of 2).	12th Exam I: in-class
17th No classes: Spring Break	19th No classes: Spring Break
24th **15** **Fraleigh: IV.18.** **Judson: 16.1.** Review of ring theory: definitions and examples.	26th **16** **Fraleigh: V.26.** **Judson: 16.2, 18.1.** Review of ring theory: fundamental theorems.
31st **17** **Fraleigh: IV.19, IV.21.** **Judson: 16.3.** Integral domains and fields of fractions.	Apr 2nd **18** **Fraleigh: V.27.** **Judson: 16.4.** Maximal ideals and prime ideals.
7th **19** **Fraleigh: V.22.** **Judson: 17.1.** Polynomial rings: definitions and first properties.	9th **20** **Fraleigh: V.23.** **Judson: 17.2.** Polynomial rings: irreducible, prime, maximal.
14th **21** **Fraleigh: V.23.** **Judson: 17.3.** Irreducibility criteria for polynomials.	16th **22** **Fraleigh: IX.45.** **Judson: 18.2.** Unique Factorization Domains.
21st **23** **Fraleigh: IX.45.** **Judson: 18.2.** Principal Ideal Domains.	23rd **24** **Fraleigh: IX.46, IX.47.** **Judson: 18.2, 18.3.** Euclidean Domains; examples and non-examples.
28th **25** **Fraleigh: VI.29, VI.31.** **Judson: 21.1.** Algebraic and transcendental field extensions.	30th **26** **Fraleigh: X.50.** **Judson: 21.2.** Splitting fields.
May 5th **27** **Fraleigh: X.48, X.53.** **Judson: 23.1, 23.2.** Galois theory: introduction and philosophy.	7th **28** **Fraleigh: X.54, X.56.** **Judson: 23.3.** Galois theory: solvability and examples.

Comet Creed: This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do"

Academic Support Resources: The University's academic support resources for all students are detailed in the following link: Academic Support Resources.

UT Dallas Syllabus Policies and Procedures: The University's policies and procedures concerning course syllabi are available at the following link: UT Dallas Syllabus Policies.

The descriptions and timelines contained in this syllabus are subject to change at the Instructor's discretion.