Math 3613, Introduction to Abstract Algebra Fall 2018

Course Information

Professor: Dr. Lisa Mantini, 410 Math Sciences
- ▷ Telephone 405–744–5777,
- ▷ Email: lisa.mantini@okstate.edu,
- ▷ FAX number: 405–744–8275.
- ▷ Course Times: MWF 9:30–10:20 AM in 514 MSCS.
- ▷ Instructor's office hours: TW 1:30-2:20 PM, R 11:30-12:20 PM, and by appointment.

Course Objectives: This course is required for all math majors and recommended for students who wish to pursue the mathematics minor or advanced study in mathematics. It has two major goals:

- ▷ It introduces you to the logic and reasoning skills that are essential in mathematical proof and which play a fundamental role in the deductive reasoning used in advanced mathematics and in many other subjects. To this end, it emphasizes the reading and writing of mathematical arguments.
- ▷ This course also introduces you to elementary number theory and to the beginning ideas in abstract algebra. These ideas are essential for continued study of areas such as number theory, cryptography, group theory, symmetry, advanced linear algebra or abstract algebra, and many other areas. They also provide needed background for future secondary teachers relevant to the algebra that will be taught in high school math. The topics covered will include prime numbers and factorization, divisibility and the Euclidean algorithm, congruence and modular arithmetic, an introduction to rings, and polynomials and factorization.

Prerequisites: Successful completion of Math 3013, Linear Algebra, with a grade of C or better is required for this course.

Texts: Both texts (1) and (2) are required.

1. *How To Prove It: A Structured Approach*, second edition, by Daniel Velleman,
2. *Abstract Algebra: An Introduction*, third edition, by Thomas Hungerford.

Syllabus: The following topics are covered in this course:

- Velleman Chapter 1: Sentential Logic, section 1.1–1.5
- Velleman Chapter 2: Quantificational Logic: sections 2.1–2.2
- Velleman Chapter 3: Proof Strategies: sections 3.1–3.6
- Velleman Chapter 4: Relations, section 4.1
- Velleman Chapter 5: Functions, sections 5.1–5.2
- Velleman Chapter 6: Mathematical Induction, sections 6.1 and 6.4
- Hungerford Chapter 1: Arithmetic in $\mathbb{Z}$ revisited, sections 1.1–1.3
- Hungerford Chapter 2: Congruence in $\mathbb{Z}$ and Modular Arithmetic, sections 2.1–2.3

- Hungerford Chapter 3: Rings, sections 3.1–3.3
- Hungerford Chapter 4: Arithmetic in the Polynomial Ring $\mathbb{F}[x]$: sections 4.1–4.6

Course Requirements: There are 650 total points required, as follows:

- Homework (about 11 assignments) and occasional in-class worksheets or quizzes, worth 150 points (23% of your grade);
- Midterm Exams (3) worth 300 points (each worth 100 points or 15.4% of your grade), tentatively scheduled on
  - Wednesday, September 26,
  - Wednesday, October 24, and
  - Wednesday, November 28.
- Comprehensive final exam on Wednesday, December 12 at 8:00 AM, worth 200 points (30.8% of your grade).

Grading: Preliminary grade cutoffs, which maybe lowered but not raised, are:

- 585 points (90%) guarantees an A in the course
- 520 points (80%) guarantees a B
- 455 points (70%) guarantees a C
- 390 points (60%) guarantees a D

Homework: Homework will be assigned and collected approximately weekly. Selected problems will be graded before the assignment is returned to you. Solutions will be posted on the class D2L site, and I highly recommend consulting these, to check solutions I do not grade, and to learn what I expect, both on future homework assignments and on exams. Please prepare your homework on 8.5" by 11" sheets which are **stapled** and with **no ragged edges**. Please label each problem with the *complete* problem number, written as 1.1.5 for problem 5 from section 1.1, in the **left margin**. Please submit a solution with the problems written in the order they are assigned. Please be as neat as possible and write darkly and clearly. Work earning full credit is clear, complete, legible, containing proofs and explanations written in full, grammatically correct English sentences.

Attendance Policy: I expect that I will take attendance daily. You are permitted to miss the equivalent of one week of class (3 50-minute class periods) without consequence. Students missing 3 or fewer classes will earn a bonus of 15 points. With each additional absence, the bonus is reduced by 5 points. Students missing 6 class periods or more will earn no attendance bonus.

Academic Integrity: Oklahoma State University is committed to the maintenance of the highest standards of integrity and ethical conduct of its members. This level of ethical behavior and integrity will be maintained in this course. Participating in a behavior that violates academic integrity (e.g., unauthorized collaboration, plagiarism, multiple submissions, cheating on examinations, fabricating information, helping another person

cheat, unauthorized advance access to examinations, altering or destroying the work of others, and fraudulently altering academic records) will result in your being sanctioned. Violations may subject you to disciplinary action including the following: receiving a failing grade on an assignment, examination or course, receiving a notation of a violation of academic integrity on your transcript (F!), and being suspended from the University. See academicintegrity.okstate.edu.

Regarding homework assignments in this course, you are permitted to discuss problems with classmates, but you must write all of your solutions independently. Work which you submit to me bearing your name must be written by you, so you should be able to explain it to me verbally if we are talking about it. I have the right to ask you to explain any solution you submit. Reading solutions written by classmates before you turn in your own assignment is not permitted, and showing your written work to classmates who have not yet turned in their assignment is also not permitted.

Course Calendar: Here is an approximate course schedule. V$n.m$ refers to a section from the Velleman textbook; H$p.q$ refers to sections from the Hungerford book.

Week of	**Monday**	**Wednesday**	**Friday**
20 Aug	Intro, V1.1	V1.1, V1.2	V 1.2, V1.4
27 Aug	V1.4, V1.5	V1.5, V2.1	V2.1, V2.2 [Asn 1 Due]
3 Sept	*Labor Day Holiday*	V3.1	V 3.2 [Asn 2 Due]
10 Sept	V3.3	V6.1	V6.4, V4.1 [Asn 3 Due]
17 Sept	V4.1, V3.4	V3.5, V3.6	Start H1.1 [Asn 4 Due]
24 Sept	**Review**	**Exam 1**	H1.1
1 Oct	H1.1, H1.2	H1.2	H1.3 [Asn 5 Due]
8 Oct	H1.3, H2.1	H2.1	H2.2 [Asn 6 Due]
15 Oct	H2.2, H2.3	H2.3	*Fall Break Holiday*
22 Oct	**Review** [Asn 7 Due]	**Exam 2**	H3.1
29 Oct	H3.1	H3.2	H3.2
5 Nov	H3.3	H3.3	H4.1 (*last W*) [Asn 8 Due]
12 Nov	H4.1	H4.2	H4.3 [Asn 9 Due]
19 Nov	H4.3	*Thanksgiving holiday*	*Thanksgiving holiday*
26 Nov	**Review** [Asn 10 Due]	**Exam 3**	H4.4
3 Dec	H4.5, H4.6	H4.6	**Review** [Asn 11 Due]
10 Dec	**Review**	8:00 am, **Final Exam**	

Assignment List: You should read each of the listed sections before doing the assigned problems. Section "V$n.m$" is from the Velleman book; all other sections are from the Hungerford book. Starred problems in Velleman are answered in the back of the book. The Hungerford book also contains selected solutions, but they are not marked.

Asnmt.	**Due Date**	**Sections**	**Math 3613 Problems assigned**
1	31 Aug	V1.1	2, 4, 6, 7
		V1.2	2, 4, 8, 12, 17
2	7 Sept	V1.4	(practice 2, 4) 5, 8, 9, 11
		V1.5	2 a–b, 3, 5, 10
		V2.1	2 a–b, 5, 7, 8
		V2.2	2, 3, 7, 9, 10
3	14 Sept	V3.1	2, 3, 8, 12, 15, 16
		V3.2	3, 7, 12
		V3.3	2, 6, 18, 19, 20, 21
4	21 Sept	V6.1	2, 5, 6, 11
		V6.4	4
		V4.1	(practice 4) 3, 5, 6, 7, 10
		V3.6	2, 3
Exam 1	26 Sept	above	Covers Assignments 1–4
5	5 Oct	1.1	2, 4, 8, 9, 10
		1.2	1 b, d, f, h; 4b; 6, 8, 11, 14, 15 c, d, j; 17
6	12 Oct	1.3	1 b, d; 2, 4, 6, 16, 17, 18
		2.1	2, 4, 6, 9a, 10, 14, 16
7	22 Oct	2.2	1 b–c, 2, 4, 6, 10 (parts 3 & 7), 12
		2.3	1, 2, 3, 6, 8, 10
Exam 2	24 Oct	above	Covers Assignments 5–7
8	9 Nov	3.1	3, 5 c–d, 8, 9, 12, 15b, 16, 20
		3.2	1, 2, 6, 8, 12, 16, 20, 21a, 22
9	16 Nov	3.3	2, 4, 5, 9, 10, 12, 14
		4.1	1 b, d; 3b, 5b, 6 a–c, 8, 9, 10, 11
10	26 Nov	4.2	3, 4, 5b, d, e; 6 b, d, e
		4.3	1b, 3b, 9b, 10, 12, 13, 14
Exam 3	28 Nov	above	Covers Assignments 8–10
11	7 Dec	4.4	2 b, d; 3 b, d; 4, 7, 8, 13
		4.5	1 a, b, d, f; 4
		4.6	1 b, 2, 3
Final Exam	12 Dec	**8:00 AM!!**	Covers Assignments 5–11

Makeup exams: An occasional late homework assignment may be allowed by request, with possible grade penalty, until the solutions for that assignment are published on

D2L. No late homework will be accepted after the solution for that assignment has been published. Makeup exams will be given **only** for very serious and unavoidable extenuating circumstances and **only** if you notify me before or as soon as possible after the missed exam.

Drop Policy: The last day to drop the course with no grade and no fees is Monday, August 27. The last day to drop the course with no grade and a partial refund of fees is Friday, August 31. The last day to drop the course with an automatic grade of W is Friday, November 9.

Study Hints: This class emphasizes the reading and writing of proofs and the structure of mathematical arguments. Students will find that you must work on developing understanding of definitions, lemmas, theorems and every step of an argument. You will not be able to do well by attempting to imitate what I do without developing understanding. You will probably find that theoretical material is impossible to master at the last minute (new ideas need time to be absorbed and processed), so your work on each problem set should be started well in advance. Your goals in this course will include skills to develop (1–2) and facts to know (3–5):

1. **Proofs** that you read should be understood, so you can decide if they are correct. Proofs you write should be in paragraph form, with clearly written, grammatically correct sentences using precise language that says exactly what you mean.
2. **Computations** involving modular arithmetic, common divisors, polynomial factorization, and other topics should be done accurately and written up clearly.
3. **Definitions** must be memorized, stated accurately, and used correctly in proofs.
4. **Theorems** that we study should be stated accurately and their proofs should be understood. Theorems should be used correctly as steps in other proofs. You should be able to write your own proofs of results that are similar to the easier theorems we study or to proofs done in homework.
5. **Examples** should be given illustrating the truth of the theorems we prove, or counterexamples illustrating why certain other statements are false.