Course Guide Abstract Algebra II: Spring 2026:

	Topic	D & F	
M: 1-19	Lecture 1: symmetries and equations, on why we study abstract algebra		
W: 1-21	Lecture 2: group actions, the orbit stabilizer theorem & the class equation		
F: 1-23	Lecture 3: Sylow Theorems and group theory story time		
M: 1-26	Lecture 4: basic definitions and examples of rings	7.1 & 7.2	
W: 1-28	Lecture 5: ring homomorphisms and quotient rings	7.3	
F: 1-30	Lecture 6: properties of ideals	7.4	
M: 2-2	Lecture 7: rings of fractions	7.5	
W: 2-4	Lecture 8: the Chinese remainder theorem	7.6	
F: 2-6	Lecture 9: Euclidean domains	8.1	
M: 2-9	Lecture 10: Principal Ideal Domains	8.2	
W: 2-11	Lecture 11: Unique Factorization Domains	8.3	
F: 2-13	Lecture 12: definitions and basic properties of polynomial rings	9.1	
M: 2-16	Lecture 13: polynomial rings over fields part 1	9.2	
W: 2-18	Lecture 14: polynomial rings that are UFDs	9.3	
F: 2-20	Lecture 15: irreducibility criteria & polynomial rings over fields part 2	9.4 & 9.5	
M: 2-23	Questions		Mission 1
W: 2-25	Boss Fight 1		
F: 2-27	Lecture 16: Basic theory of field extensions	13.1	
M: 3-2	Lecture 17: Algebraic field extensions	13.2 & 13.3	
W: 3-4	Lecture 18: Splitting fields and algebraic closures	13.4	
F: 3-6	Lecture 19: Separable and inseparable extensions	13.5	
M: 3-9	Lecture 20: Cyclotomic polynomials and extensions	13.6	
W: 3-11	Lecture 21: basic definitions for Galois Theory	14.1	
F: 3-13	Lecture 22: The Fundamental Theorem of Galois Theory	14.2	
	Spring Break 3-16 to 3-20		
M: 3-23	Lecture 23: The Fundamental Theorem of Galois Theory	14.2	
W: 3-25	Lecture 24: Galois Groups of Polynomials	14.6	
F: 3-27	Lecture 25: Radical Extensions and Insolvability of the Quintic	14.7	
M: 3-30	Questions		Mission 2
W: 4-1	Boss Fight 2		
F: 4-3	Lecture 26: basic definitions and examples of modules	10.1	
M: 4-6	Lecture 27: quotient modules and module homomorphisms	10.2	
W: 4-8	Assessment Day (no class)		
F: 4-10	Lecture 28: generation of modules, direct sums, and free modules	10.3	
M: 4-13	Lecture 29: tensor products of modules	10.4	
W: 4-15	Lecture 30: tensor algebras, symmetric and exterior algebras	11.5	
F: 4-17	Lecture 31: basic theory of modules over PIDs, classification of finite Abelian groups	12.1	
M: 4-20	Lecture 32: the rational canonical form vs Jordan form	12.2 & 12.3	
W: 4-22	Lecture 33: Smith normal form and abelian groups		
F: 4-24	Lecture 34: Introduction to Category Theory		
M: 4-22	Lecture 35: adventures in algebra part 1		
F: 4-24	Lecture 36: adventures in algebra part 2		
M: 4-27	Lecture 37: adventures in algebra part 3		
W: 4-29	Lecture 38: adventures in algebra part 4		
F: 5-1	Questions		Mission 3
M: 5-4	Boss Fight 3		
W: 5-6	Reading Day		
F: 5-8	1:00-3:00, Final Quest		

- **Textbook:** *Abstract Algebra*, by Dummit and Foote, 3rd Edition (it is available in the Jerry Falwell Library)
- **Lectures:** based largely on D&F, but I am looking at about 6 books to source examples etc., pdfs to be posted.
- **Grades:** Boss Fights 1,2,3 = 3(200pts)=600pts, Final Quest = 100pts, Missions 1,2,3 = 3(100pts) = 300pts.

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Missions: there are three missions, each is worth 100pts. Pdfs of these will be provided.

Boss Fights: work to understand the Lectures before this in-class, closed-notes and book exercise.

Final Quest: consists of a paper and talk are on the same topic. The paper should help you prepare for your talk. Since there are 7 students and the Final Exam time is 120 minutes we should plan for 15 minute talks. Your talk must be emailed to me in pdf or powerpoint format in advance of the final exam period. You will be using my laptop for the presentation in the interest of reducing the inevitable tech failure. The paper is 7 pages, it can be handwritten, it should attempt to communicate the central definitions of the topic assigned, the major theorem (if there is one) and some examples or counterexamples. I will work with you to decide your topic before Test 1, it should be on a topic which was either under-emphasized or missing from the 421/422 sequence this year. For example, possible topics would include:

- Symmetries of the Euclidean plane, derive them & illustrate their function in art and geometry (this is in Artin)
- Mathematics of the Rubik's Cube (I have an article you could digest)
- Class Field Theory (there is a section in Artin's algebra book)
- Proof of Hurwitz Theorem (R,C,H only real division algebras)
- The four squares theorem and its application to number theory (I think this is in the book by Stillwell)
- Maximal Tori in matrix Lie groups (Tapp's book is a good source here, although row vectors are annoying)
- Lie Algebras: what is a Lie Algebra ?
- Supernumbers: what is a supernumber and what are their properties
- Superspace: given supernumbers, how do we construct superspace, describe it in the language of modules
- Spinors: what is a spinor, explain their relation to the Lorentz group
- Quivers: what is a quiver ? (I have an article for you to digest and explain to the class)
- Algebraic Geometry (what is a variety, there is a section in Rotman's elementary abstract algebra text you would digest)
- P-adic Numbers (book by Gouveia should give you some ideas)
- Differential Galois Theory (my brother has a handout you can work to understand)

Side Quests:

- Solve a Rubik's cube in less than 67 seconds, earn 10pts / Solve it in less than 30 seconds, earn 20pts / blindfolded adds 10pts.
- Participate in speed dating event or take a math major you don't know well to lunch or dinner, earn 10pts.
- Scare Mrs. Guthrie with a fake spider, earn 10pts.
- Other side quests to appear later, probably more mathematical.

Instructions for Missions and some Advice on Studying: (you all probably know this already, I include as a default in courses now)

- Write solutions neatly on only one side of paper
- Staple with metal staple (not paper clip, binder, string, gum etc.) in the upper left corner. Do not obscure your work with the staple
- Put your solutions in order, if there is an answer to be found then box the answer. If the problem is a proof, be sure to use words and proper mathematical notations. The proof should be complete without your reader needing to see the statement of the problem.
- If a problem is skipped, be sure to include the number in the solution and some blank space to indicate the missing problem.
- If you use a website or software to do a calculation then mention that you did this. However, be warned, you do need to get up to speed in the routine calculation.
- Be careful not to work together too much. If anything there is too much group work these days. You may work together, but be careful to share ideas not steps. I encourage you to check if your answers and results align with your peers, but when they don't you ought not merely copy their work! Furthermore, you need to start homework early enough that you have time to ask questions. I have many office hours for questions.
- Scratch work matters. You should show steps.
- Be sure to scan your work, it may not be possible to return the Missions to you before the test. I try to return them soon, but weather and life at times interferes. Solutions will be posted, so you can always check your scanned work against the solution even if the original is not yet returned.
- Grading is likely done by me this Semester. I will probably not have time to grade all problems. So, it is likely I randomly choose a few to grade then use that to create a multiplier for the number attempted. Copying the problem statement does not constitute an attempt. An attempt means I see evidence of thinking on the problem and trying something intelligent towards a solution. For example, suppose the assignment has 20 problems. You attempt 16 of the 20 problems. I randomly select 3 to grade. Suppose you skipped one, but did the other two nearly perfect then the score would be (2/3)*(16)*3 = 32pts,
- First failure to adhere to instructions to Missions is free. Thereafter, I deduct points. Probably nonlinearly.