MATH 401 : INTRODUCTION TO ABSTRACT ALGEBRA

Aurélien Sagnier

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Teacher :

- Aurélien Sagnier, asagnie1@jhu.edu, Mondays $15:00 \to 16:00$ and Wenesdays $13:45 \to 14:45$ or by appointment, Krieger 219

Teaching Assistant :

- Naruki Masada, nmasuda2@jhu.edu, Fridays $13:30 \to 14:30$ Krieger 211, Wed $11:00 \to 13:00$ Math help room or by appointment.

Lectures : Mondays and Wenesdays $12:00 \to 13:15$, Hodson 315

Exercise sessions : Fridays $12:00 \to 13:15$, Hodson 315

Warning : This is probably your first proof-based mathematics course. Your *first job* in this course will be to learn the definitions and the statements of the theorems and properties seen in class. It is *crucial* that you learn those first. Once this is done, you should work on your own or by groups on examples and especially the ones proposed in problem sets since we will spend very few time together in class. Mathematical confidence will come from learning the statements of definitions and theorems and from practising on many examples.

Textbook : *Groups and Symmetry*, M.A.Armstrong, UTM Springer (approximately chapters 1 to 23). I will not follow completely the exposition of the textbook but in the end the same amount of maths will be covered. Other useful (but optional) references on specific subjects will be indicated in class. For the material (basic logic and arithmetics) not covered in the textbook, you can look in the free online book *https://infinitedescent.xyz/*.

Classroom climate : In classroom, everyone will be treated with respect and dignity. If in class you don't understand what I said or wrote on the board, feel free to ask me to repeat. If you have a mathematical question in class, take 30-60 seconds to try to answer it by yourself (self-discovery is very important in mathematics) and if you can't feel free to ask me. I intend to create a friendly and suited for learning climate. If you have constructive criticism or remarks on the lectures feel free to tell me too. If you have mathematical questions on group theory in general or if you seek more ressources, feel free to ask me, I will do my best to answer you.
It will be your first course of abstract algebra so you should expect to be challenged intellectually by me, Naruki or your peers and this may sometimes cause a little discomfort but you should never give up and be brave, being pushed to your limits might help you to learn more and develop your mathematical abilities. However this discomfort should never lead to anxiety, stress, depression, ... if so please come to see me or Naruki immediately and we will try our best to help you.
If you ever have concerns about harassment, discrimination, unfair treatment, please share it with me or Naruki. We will take your concerns seriously and try our best to find a solution. Reporting a concern would never impact your grade and your privacy will be preserved as much as possible. You can also, if needed, share your concerns with the Department Chair (David Savitt, savitt@math.jhu.edu), the Director of Undergraduate Studies (Richard Brown, brown@math.jhu.edu), the Assitant of the Dean for Diversity and Inclusion (Darlene Saporu, dsaporu@jhu.edu) or the Office of Institutional Equity (oie@jhu.edu).

Wellbeing :

- Any student with a disability who may need accomodations in class should contact me as early as possible to discuss their needs and must also obtain an accomodation letter from Student Disabilities services (385 Garland, 410-516-4720, web.jhu.edu/disabilities, studentdisabilitiesservices@jhu.edu)

- If you are very sick and contagious, please warn be by email and you will be excused from coming to class. The JHU Student Health and Wellness center is located at 1 East 31 Street, 410-516-8270

- If you are struggling with anxiety, stress, depression or mental health related concerns or if a friend of yours is struggling with those, please seek out for help at JHU Counseling Center located at 3003 North Charles Street in Suite S-200, 410-516-8278, studentaffairs.jhu.edu/counselingcenter/

Support : If you are stuck on a problem of the homework or by a statement or a proof seen in class, first try to take some time to try to solve the problem yourself. Self-discovery, even if you are not able to solve entirely the problem, is a very important part of the learning process. After trying to solve the problem by yourself, I advise you to ask your classmates for help. You will learn a lot from working together and putting the mathematical ideas in your own words. Of course if you need further help you can reach me at my office hours whch will be held on time specified at the beginning or by appointment in Krieger 219. Naruki's office hours will be help on Fridays $13:30 \to 14:30$ Krieger 211, Wed $11:00 \to 13:00$ Math help room or by appointment. If your problem cannot wait, the Math Help Room is open $9\,\text{am} \to 9\,\text{pm}$ Monday-Thursday and $9\,\text{am} \to 5\,\text{pm}$ on Friday.

Grading : It will be a numerical grade based on the following formula :

- 1/7 Oral exercise sessions
- 2/7 Problem sets
- 2/7 Midterm
- 2/7 Final take home exam

Just a point on *ethics*: in this course you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of internet and ressources, unauthorised collaboration (see also section on Problem sets), alteration of graded assignments, forgery and falsification, lying,... In this course the John Hopkins Ethics Guide will apply : http://e-catalog.jhu.edu/undergrad-students/student-life-policies/

Oral exercise sessions : Here how it will be organized : during the first week you will pair with other students by groups of 3 (since 6 students are enrolled so far : 2 groups of 3). Those groups will be fixed for the rest of the semester (unless exceptionnal excuse). The sessions will begin during the second week. The oral sessions of one hour will be held at Wednesdays $17{:}30 \to 18{:}30$ in my office Krieger 219 every week. There will be a turnover between groups for taking those exercise sessions and so each group will have a session every other week. During a session no notes will be allowed and each member of the group will be at the blackboard and will be assigned an exercise on which he will begin to work immediately. You shouldn't feel *any pressure* though, the aim of those exercises is to train you to think at the blackboard and expose your ideas while you are still in the process of thinking. The point of those sessions is not necessarily to solve completely the given problem but rather to do maths orally on the blackboard. You can be sure to get a very correct grade if you arrive at the session knowing the statements of the definitions and of the theorems seen in class and if you show good will during the session.

Problem sets : Except for the first week and the week of midterm, a problem set will be due (unless exceptionnal excuse) each week and will have to be handled in class on Wenesdays. You can collaborate and work on those problem sets together, I encourage it *however* each student must write down the solutions in their *own* words and *own* mathematical style and write the name of their collaborators on the written assignments. Copying directly from someone else or from an another ressource is strictly prohibited.

Midterm: It will be a written exam held in class Wenesday 26th February.

Take home exam: The second midterm exam will be a comprehensive take home exam consisting on several exercises whose topics will cover the full scop of notions and techniques seen in this course. It will be given Saturday 2nd May and will be due for Monday 4th May. For this take home exam, no collaboration is allowed.

Approximate schedule :

- Jan M 27th: Vocabulary on sets, mathematical statements, logical operations and quantifiers
- Jan W 29th: Quantifiers and proof methods
- Feb M 3rd: Functions, in/sur/bi-jections
- Feb W 5th: Cardinality, Equivalence relations (A12)
- Feb M 10th: Basic vocabulary of groups (A2-3-4-5)
- Feb W 12th: Homo/iso-morphisms (A7)
- Feb M 17th: Class modulo a subgroup, Quotient groups (A15)
- Feb W 19th: Modular arithmetic, Euclidean algorithm
- Feb M 24th: Euclidean algorithm and Bezout theorem
- Feb W 26nd: MIDTERM (in class)
- Mar M 2nd: Isomorphism theorems (A16)
- Mar W 4th: Group actions (A8-14-17)
- Mar M 9th: Permutation groups (A6)
- Mar W 11th: Class formula and 1st Sylow theorem (A18-20)
- Mar M 23rd: Sylow theorems and applications (A20)
- Mar W 25th: Products of groups (A10)
- Mar M 30th: Generators and Cayley graphs
- Apr W 1st: Semi-direct products (A23)
- Apr M 6th: Groups of given small cardinal
- Apr W 8th: Classification of finitely generated abelian groups (A21)
- Apr M 13th: Classification of finitely generated abelian groups (A21)
- Apr W 15th:Classification of finite abelian groups (A21)
- Apr M 20th: SO(3) (A9-24)
- Apr W 22nd: Plato solids (A8-19)
- Apr M 27th: Plato solids (A8-19)
- Apr W 29th: Groups and geometry