Math 322: September 2021

Time: TuTh 1400:1530
Place: Frank Forward 303
Instructor: Vinayak Vatsal (Math 222c)
Instructor email: lastname at math-ubc-ca (use dots instead of dashes)
Office Hours: Wednesday afternoon 1300:1350, Math 222c
Objectives: This course is an introduction to modern algebra, which, together with analysis, is one the two basic building blocks of all mathematics. Groups are the first examples of abstract algebraic objects, and this course is focused on their properties.

Students will learn how to deal with multiplication in abstract groups, to manipulate abstract quantities, and to prove theorems about general abstract groups. You will be expected to work in situations where examples are hard to find, and often misleading. By the end of the class, students should be sufficiently familiar with groups to move on to the next level of algebraic complexity as embodied by fields and rings.

Students should be aware that the nature of the material will be quite different from other courses they may have taken. Clear and precise mathematical writing is a will be required — all students should be comfortable writing moderately complex proofs.

Pre-requisites: Either (a) a score of 68% or higher in one of MATH 223, MATH 310 or (b) one of MATH 152, MATH 221, MATH 223 and a score of 80% or higher in MATH 220

Recommendation: It is strongly recommended that you take Math 312 in conjunction with this course. The material is closely connected, and your understanding of both classes will be improved.

Textbook: We will primarily follow the book *Basic Algebra I*, by Nathan Jacobson. This book is required. We will occasionally refer to the books by Roman and Herstein listed below.

Other references include
- Dummit and Foote, *Abstract Algebra*;
- Rotman, *An Introduction to the Theory of Groups* (this book is available at no cost, online from Springerlink, accessible through the UBC Library);
- Herstein, *Topics in Algebra* (out of print; available online)

Homework: There will be weekly homework, typically due on Tuesdays at 11:59pm, together with weekly readings. I recommend that you keep up with the readings, and read in advance of class. All homework will be taken from the textbook. If you are using some book, it is your responsibility to find the homework questions.

Math 322: September 2021

Homework submissions must be typeset and uploaded to Canvas in PDF format. I recommend using LaTex, as it is the standard system, is free, and produces the most readable mathematics. It is also the standard means to write mathematics in Piazza. Some of you may have used LaTeX in other courses as well.

You are of course free to use any typesetting system of your choice, but any difficulty you may experience in producing intelligible mathematics is your own responsibility.

For those of you who have never seen LaTeX before, I have assembled a solution template and some online resources in Homework Set 0 on the course Canvas page. You can also ask me for help.

Piazza: There is a course Piazza page on Canvas. I will check in periodically and answer questions, to the extent that it is possible on-line. But owing to the complicated nature of the material, it might be easier to come to office hours or to make an appointment if the set times are inconvenient.

Notes: Notes from class will be uploaded to Canvas

Exams:

- Midterm 0, in class, **September 22**,
- Midterm 1, in class on **October 20**,
- Midterm 2, in class, **November 17**
- **F**inal exam set by the University.

Assessment: 5% homework, 10% midterm 0, 15% Midterm 1, 20% Midterm 2, 50% final.

Math 322: September 2021

Syllabus and course schedule (preliminary; subject to change)

Week 1 September 8: Equivalence relations and the integers (Read Jacobson 0.1-0.6)

Week 2 September 13, 15: Monoids and groups of transformations, abstract monoids and groups, Cayley's theorem (Jacobson 1.1-1.3).

Week 3 September 20, 22: Associativity, commutativity, submonoids and subgroups (Jacobson 1.4, 1.5). Midterm 0 in class.

Week 4 September 27: Cycle decomposition of permutations, orbits(Jacobson 1.6, 1.7)

Week 5 October 4, 6: Cosets, congruences, quotients (Jacobson 1.7, 1.8, 1.9)

Week 6 October 11, 13: Subgroups of a homomorphic image, isomorphism theorems, free objects (Jacobson 1.10, 1.11)

Week 7 October 18, 20: Midterm 1, groups acting on sets (Jacobson 1.12)

Week 8 October 25, 27: Groups acting on sets, Sylow theorems (Jacobson 1.12, 1.13)

Week 9 Nov 1, 3: Sylow theorems, Finite abelian groups, finitely generated abelian groups (Jacobson 1.12, Rotman Chapter 6)

Week 10 Nov 8: Finite abelian groups, finitely generated abelian groups (Rotman Chapter 6). Midterm break

Week 11 Nov 15, 17: simplicity of alternating groups (Jacobson 4.6) (Midterm 2)

Week 12 Nov 22, 24: Additional topics to be decided

Week 13 Nov 29, Dec 1: Additional topics to be decided

Week 14 Dec 6: Additional topics to be decided