

We recognize and acknowledge that McMaster University meets and learns on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the "[Dish With One Spoon](#)" wampum, an agreement amongst all allied Nations to peaceably share and care for the resources around the Great Lakes.

MATH 4GR3/6GR3 – Groups and Rings 2024 Winter Term

Instructor: Adam Van Tuyl | **E-mail:** vantuyl@math.mcmaster.ca | **Office:** HH/419

Location: (See Avenue to Learn) | **Time:** MWTh 1:30-2:30PM

Class Website

https://ms.mcmaster.ca/~vantuyl/courses/2024_winter_math4GR3.html

Course Description

Further topics in group theory and ring theory. Topics include: direct products, Fundamental Theorem of Finite Abelian Groups, Sylow Theorems, free groups, group presentations, fields and integral domains, special integral domains (Euclidean, principal ideal, unique factorization), fields of fractions of integral domains, polynomial rings in many variables, and additional topics at the discretion of the instructor (e.g., Groebner bases, algebraic coding theory).

Prerequisite(s): MATH 3E03 or [3GR3](#)

Course and Learning Objectives

Learning Objectives

Upon completion of this course, the student will be able to:

1. Understand fundamental concepts in algebra relating to groups, rings and fields.
2. Understand key structure results (e.g., Sylow theorems) about groups and rings.
3. When applicable, apply symbolic computations involving these objects
4. Present a result (via a poster) of key algebraic results.

Class Activities:

The current plan is to offer this course **in person**. The lectures will be traditional blackboard talks.

Students are expected to participate; there will be no video recordings. If health guidelines change, we will move to a virtual class (and further details will be provided).

Required Materials and Resources

1. **Primary Reference:** Abstract Algebra: Theory and Applications, by Thomas Judson
Available (free) online: <http://abstract.ups.edu/> (We will use the 2022 edition; you can purchase a hardcopy if you wish)

Course Overview and Assessment

A tentative list of topics to be discussed (a week-by-week breakdown will be provided on the class website)

1. Groups Review
2. Finite Abelian Groups
3. Soluble Groups
4. Group Actions
5. Class Equations
6. Burnside Counting
7. Sylow Theorems
8. Applications of Groups (e.g. RSA)
9. Rings Review
10. Polynomial Rings
11. Division Algorithm
12. Irreducible Polynomial
13. Integral Domains
14. Fields (extension fields, splitting fields)
15. Applications of Fields (geometric construction)
16. Fundamental Theorem of Algebra (if time)

We will cover the following chapters of Judson: Chapters 13, 14, 15,17, 18, 21, portions of 22



Evaluation

The evaluation is based upon four components; the higher of the following two grading schemes will be used.

ASSESSMENT	WEIGHT 1	WEIGHT 2
1. Homework Assignments (five)	25%	25%
2. Midterm	20%	0%
3. Poster	15%	15%
4. Final Exam	40%	60%

Homework assignments will be bi-weekly, for a total of five assignments. Homework will be submitted via Crowdmark. There will be one midterm (**provisionally February 15**) and one final exam. There will also be a project, involving groups of two-three students, that will involve creating a poster on an algebraic topic, and presenting the poster in class. Further details will be provided in class. Students in Math 6GR3 will have the same requirements.

Requests for Relief for Missed Academic Term Work

(For undergraduates only) [McMaster Student Absence Form \(MSAF\)](#): In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar “Requests for Relief for Missed Academic Term Work”. ***In Math 4GR3, the weight of missed work will be moved to the final.***

Policy Regarding Missed Work

(For undergraduates only) Requests for missed academic work worth less than 25% of the final grade resulting from personal or medical situations, lasting up to 3 calendar days, can be reported, once per term, without documentation, using the McMaster Student Absence Form (MSAF). Relief for missed work for a longer duration or for other reasons must be reported to your Faculty office, and relief from term work may not necessarily be granted. When using the MSAF, report your absence to the course instructor or designate. You must then contact the Instructor/Instructional Assistant/other immediately (normally within 2 working days) by e-mail. Please refer to the contact list on the first page of this outline for appropriate e-mail addresses. The Instructor/Instructional assistant will indicate what relief may be granted for the work you have missed, and relevant details such as revised deadlines, or time and location

of a make-up exam/quiz/test. Please note that the MSAF may not be used for final deliverables, nor can it be used for a final examination or its equivalent. Please [review and follow the Academic Regulation in the Undergraduate Calendar under “Requests for Relief for Missed Academic Term Work” here.](#)

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact [Student Accessibility Services \(SAS\)](#) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

Academic Accommodation for Religious, Indigenous Or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Courses with an On-Line Element

In this course we will be using Crowdmark. Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used.

Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins. If you have questions or concerns about the use of the proctoring software, please contact the Instructor. **In Math 701, we will not use online proctoring software.**



Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process.

Academic credentials you earn are rooted in principles of honesty and academic integrity.

It is your responsibility to understand what constitutes academic dishonesty.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy, located here.](#)

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism Detection

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty. Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster’s use of Turnitin.com [please go to the office of Academic Integrity website.](#)

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities \(the “Code”\)](#). All students

share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Senate Student Policies

[Students can view full policies here on the University Secretariat website.](#) Senate Policy Statements are also available from the Senate Secretariat Office, Room 104, and Gilmour Hall.

Student Code of Conduct

You acknowledge that your behavior in all aspects of this course should meet the standards of the McMaster University Student Code of Conduct. You understand that any inappropriate behavior directed against any of your colleagues, teaching assistants, or the instructional team will not be tolerated. Disruptive behavior during any session (e.g. lecture, seminar, lab, tutorial) such as talking, sleeping or non-class computing while an individual presents information, or constantly being late, will also not be tolerated. Abuse, ridicule, slander, inappropriate language, and discrimination towards instructors teaching staff, teaching assistants and other students will not be tolerated in any capacity. Shared spaces including e-spaces such as the Avenue to Learn course discussion board are to be considered inclusive and safe. [For more information, please follow this link.](#)

Inclusivity and Academic Integrity

The University values integrity, inclusiveness and teamwork, and strives to support the personal and collective growth of the McMaster student community. These values are foundational to ensuring campus environments – both in-person and virtual – are conducive to personal wellbeing and academic success.

Inclusive Learning

McMaster University aims to foster a supportive and inclusive learning environment that encourages both individual and collective growth. Students are invited to speak with the Instructor immediately if they encounter any challenges related to accessing or using the technological requirements expected for successful participation in this course.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors. The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Additional Copyright Information

In this course students will have access to material that is subject to copyright laws. This includes (but is not limited to) textbooks and all resources developed by the Instructor such as lab manuals, demonstration videos, quizzes, assignments, tests, class notes and class slides.

Students are not allowed to share or redistribute this material in any printed or electronic form without the explicit written consent of the copyright holder. This includes posting any course material on Internet bulletin boards, course repositories, social networks, etc.

Research Ethics

NA

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.