MATH 2020: Algebra 1
Course Information Sheet and Syllabus
Winter 2018

BASIC COURSE DETAILS

Instructor: Dr. Susan Cooper

Class Times and Location: Mondays & Wednesdays & Fridays 8:30 – 9:20 a.m., 306 Buller Bldg

Tutorial Times and Location: Mondays 12:30 – 1:20 p.m., 319 Allen Bldg

Credit Hours: 3

Pre-Requisites: MATH 2090 or MATH 2091 (C) or the former MATH 2352 (C) or the former MATH 2300 (B) or MATH 2301 (B).

Note: MATH 2020 is not to be held with MATH 2021 or the former MATH 3350.

INSTRUCTOR CONTACT INFORMATION

Instructor: Dr. Susan Cooper **Email:** susan.cooper@umanitoba.ca

Office: Machray Hall, Room 464 **Office Phone:** 204-474-9701

Office Hours: Mondays & Wednesdays & Fridays 9:30 – 10:30 a.m.; or by appointment

Correspondences and Appointments: The most reliable way to contact me is via email. I will reply to an email within 24 hours of receiving it Mondays – Thursdays; an email received on a Friday will receive a reply the following Monday. All appointments are to be made via email.

Tutorial Instructor Contact Information: The Tutorial Instructor will share their contact information with you during the first tutorial meeting.

COURSE DESCRIPTION AND GOALS

"Symmetry is a vast subject, significant in art and nature. Mathematics lies at its root, and it would be hard to find a better one on which to demonstrate the working of the mathematical intellect."
— Hermann Weyl

University of Manitoba Course Calendar Description: (Lab required) The course is intended for students in mathematically rich disciplines. Groups, rings, fields: elementary concepts and examples.

General Course Description and Goals: One of the great advantages of studying mathematics is that it helps one develop the ability to handle abstract ideas. Abstract algebra allows us to cultivate this ability with concrete examples, mathematical rigor, and beautiful applications. The study of algebra involves topics that are important branches of mathematics which are thriving and intriguing in their own right. As such, it is not surprising that algebra hosts many applications to subjects such as number theory, geometry, and analysis.

MATH 2020 is a one-term undergraduate course that provides an introduction and in-depth study of the theory of groups, rings, and fields. With each topic we study sets that are endowed with algebraic structures. For rings, there are two operations (addition and multiplication) with an accompanying distributive law. The most familiar examples of rings include the integers and polynomial rings. Groups allow us to formalize the symmetries of an object (such as the three snowflakes on page 1; taken from `legacy.mos.org/discoverycenter/system/files/aotm/snowflakes+fro+web.jpg`), and applications of this idea range from the physics of boiling water in a microwave oven to the insolvability of a general polynomial of degree 5 or greater. There are fewer axioms for groups than there are for rings (and only one operation instead of two). Fewer rules allow for a greater diversity of behavior, and the absence of a second operation (with the accompanying distributive law) can make things less intuitive. When working with fields we have the operations of addition, subtraction, multiplication, and division. The real and rational numbers are both examples of fields. A deep understanding of groups, rings, and fields is fundamental to higher-level pure mathematics.

By considering concrete examples, you will make conjectures and then try to verify or disprove them. You will gain facility and become confident that you can *do* mathematics and you will experience the joy of discovering hidden patterns and mathematical truths. After successful completion of the course, students will be able to state, prove, apply fundamental theorems, and construct and work with a variety of concrete examples. In addition, students will be well-prepared for higher-level abstract algebra courses (such as MATH 3320 which focuses on groups, integral domains, and field extensions).

COURSE MATERIALS

Textbook: *Abstract Algebra: Theory and Applications*, by Thomas W. Judson, which is available for free online at

`http://abstract.ups.edu/download.html`

Course Web-Page: We will use the instructor's web-page which can be found at

`http://server.math.umanitoba.ca/~coopers5/courses_umanitoba/math2020_w18.html`

and UM Learn.

COURSE SCHEDULE AND IMPORTANT DATES

Below is an *approximate* weekly schedule of topics for our course. Also included are dates for quizzes and examinations. The topics schedule is subject to change at the discretion of the instructor and/or based on learning needs of the students but such changes are subject to Section 2.8 of ROASS (Responsibilities Of Academic Staff With Regard To Students). The quiz and examination dates will not change. *All quizzes and the mid-term examination will be administered in the Monday tutorial sessions.*

DATES	TOPICS	QUIZ
Jan. 3–5	Chapter 1: introduction to proofs, basic set theory, functions, equivalence relations	
Jan. 8–12	Chapter 2: integers, induction, divisibility, GCD, LCM, unique factorization	Quiz 1
Jan. 15–19	Chapter 3: modular arithmetic, symmetry groups, introduction to groups and subgroups	Quiz 2
Jan. 22–26	Chapter 4: cyclic groups & subgroups, lattice of subgroup, group of complex numbers, subgroup of roots of unity	Quiz 3
Jan. 29–Feb. 2	Chapter 5: permutation groups, dihedral groups	Quiz 4
Feb. 5–9	Chapter 6: cosets, Lagrange's Theorem, Fermat's and Euler's Theorems (time permitting)	Quiz 5
Mid-Term Examination: Monday, February 12 (in tutorial session)		
Feb. 12–16	Chapter 9: group isomorphisms, direct products	
No Classes: Feb. 19–23 (Winter Term Break)		
Feb. 26–March 2	Chapter 10: normal subgroups and quotients, simplicity of the alternating group	Quiz 6
March 5–9	Chapter 11: homomorphisms of groups	Quiz 7
March 12–16	Chapter 16: rings, subrings, integeral domains, fields	Quiz 8
Voluntary Withdrawal Deadline: Friday, March 16		
March 19–23	Chapter 16: supplementary examples, ring homomorphisms, ideals, quotient rings	Quiz 9
March 26–28	Chapter 16: maximal and prime ideals Chapter 17: polynomial rings	Quiz 10
No Class: Friday, March 30 (Good Friday)		
April 2–6	Chapter 17: Division Algorithm, irreducible polynomials Chapter 18: integral domains, fields of fractions (time permitting)	Quiz 11
Final Examination: Date, Time, Location To Be Determined By U of M Registrar		

ASSESSMENTS AND COURSE GRADES

Dictionary Project: The mastery of mathematics requires knowing and understanding many definitions. You will be required to construct and maintain a working dictionary. Credit will be determined by the level of completeness of the dictionary as well as correctness of the included definitions. The deadline for the dictionary submission will be announced once the final examination has been scheduled in order to maximize its use while studying for the final examination.

Suggested Exercises, Readings, and Quizzes: Mathematics is not a spectator sport. The best way to learn mathematics is by doing mathematics! A collection of suggested exercises and readings from the mathematics textbook will be announced each lecture. Although your solutions to the suggested exercises will not be collected for credit, you are highly encouraged and welcome to discuss your solutions with me for feedback either in office hours or before/after class meetings. Note that you should attempt the suggested problems regularly as the topics are presented – this will help you keep on track and make sure you have solid foundations before moving on to the next topic.

Regular quizzes will be given based on the suggested exercises and definitions from class. Calculators and reference material will not be allowed on the quizzes. The quizzes are intended to gauge your understanding of the material while presenting opportunities for you to practice writing proofs in a timed-setting. Solutions will be graded based on correctness, clarity, and style/creativity. Any necessary special grading rules will be provided beforehand. All feedback is meant to *improve* your mathematical abilities and communication. A student may earn *one* (in total) dropped lowest quiz score in the calculation of their course grade in exchange for a presentation of a solution to a challenging suggested exercise during a tutorial session. The chosen suggested exercise to be presented and the presentation date must be approved by the tutorial instructor *beforehand*.

Examinations: There will be one Mid-term examination and one 3-hour cumulative final examination. The schedule is:

Examination	**Date**	**Time and Location**
Mid-Term Exam	Monday, February 12	12:30 – 1:20 p.m., 319 Allen Bldg (in tutorial session)
Final Exam	In April – TBA	TBA (set by U of M registrar)

Calculators and/or reference material will **not** be allowed on the mid-term and final examinations. Any necessary special grading rules for the examinations will be announced and discussed prior. In general, solutions to problems will be assessed based on correctness, clarity, and style. Feedback on your solutions will be provided on your mid-term examination and is meant to improve your mathematical abilities and communication. Grades and feedback on your mid-term examination solutions will be provided prior to the Voluntary Withdrawal Deadline.

Deferred Quizzes and Examinations: Deferred mid-term examinations and quizzes will only be granted for unavoidable, documented circumstances as described below:

Circumstance	Required documentation
Illness or other medical situation	Official note from clinic, hospital, doctor, nurse, or other health care provider
Military service	Official military activation orders
Funeral or other family emergency	Official documentation from newspaper, funeral, or medical official
Sports or other official U of M activity	Official documentation from U of M athletics or activity's faculty adviser

Students who wish to request a deferred mid-term examination or quiz must contact the instructor within 2 days of the scheduled assessment (email contact is sufficient). Please note that recreational activities do not qualify for deferred examinations and quizzes. If you have a pre-existing conflict with an assessment, you are expected to make alternative arrangements *beforehand*.

As per university policy, requests for deferred final examinations are made to the student's faculty, school, or academic advising office and must be filed within 48 hours of the date of the missed examination. Full information on this policy can be found at:

`http://umanitoba.ca/student/records/finals/682.html`

Class/Tutorial Attendance and Participation: This course covers a large amount of material and may seem very fast-paced and abstract. Your understanding of the course material will be greatly supported by regular attendance and engagement in class and tutorial meetings. Although you are expected to attend every class and tutorial meeting and to fully participate in class discussions, attendance will not be taken or be used in the calculation of course grades. However, you are responsible for any missed material when absent. If time permits, we will discuss some of the suggested exercises. In such discussions, students will be asked to share their ideas. Please take your turn in these activities – it will greatly improve your understanding of the material. In particular, if you are absent from class then you will miss the opportunity to learn from your classmates.

Evaluation Scheme: Final course grades will be determined by the following scheme:

Task	Percentage of Grade
Dictionary Project	5%
Quizzes	15%
Mid-Term Examination	30%
Final Examination	50%

Note: A student may earn *one* (in total) dropped lowest quiz score in the calculation of their course grade in exchange for a presentation of a solution to a challenging suggested exercise during a tutorial session; see the section entitled "Suggested Exercises, Readings, and Quizzes".

Letter Grades: The letter grade cut-offs listed below show the minimum cut-off ranges for the course. These cut-offs may change (decrease) at the instructors' discretion.

Letter Grade	Percentage Out Of 100	Final Grade Point Value
A+	95–100	4.5
A	86–94	4.0
B+	80–85	3.5
B	72–79	3.0
C+	65–71	2.5
C	60–64	2.0
D	50–59	1.0
F	Less than 50	0

UNIVERSITY AND DEPARTMENT OF MATHEMATICS SUPPORT OFFICES AND POLICIES

A list (entitled Schedule "A") of supports available to students, including mathematical support, can be found on the course web-page(s).

EXPECTATIONS

Recording Class Lectures: Susan Cooper and the University of Manitoba hold copyright over the course materials, presentations, and lectures which form part of this course. No audio or video recording of lectures or presentations is allowed in any format (including photographs), openly or surreptitiously, in whole or in part without permission. Course materials (both paper and digital) are for the participant's private study and research.

Using Copyrighted Material: Please respect copyright. We will use copyrighted material in this course. I have ensured that the content I use is appropriately acknowledged and is copied in accordance with copyright laws and University guidelines. Copyrighted works, including those created by me, are made available for private study and research and must not be distributed in any format without permission. Do not upload copyrighted works to a learning management system (such as UM Learn), or any website, unless an exception to the *Copyright Act* applies or written permission has been confirmed. For more information, see the University's Copyright Office web-site at `http://umanitoba.ca/copyright/` or contact `um_copyright@umanitoba.ca`.

Course Technology: It is the University of Manitoba policy that all technology resources are to be used in a responsible, efficient, ethical and legal manner. During class meetings and for course quizzes/examinations/assignments, it is expected that you only use technology for educational purposes and that the only technology used is approved by myself and/or the University of Manitoba Student Accessibility Services. You should not participate in personal direct electronic message/posting activities (such as e-mail, texting, video, social networking, etc.) during scheduled class time – this is not only in your best interests for understanding the course material but is respectful behaviour for your classmates. If you absolutely need to take an expected call, then please use the vibrate mode on your cell phone and leave the classroom before using the phone.

Class Communication: You are required to obtain and use your University of Manitoba email account for all communication between yourself and the university. All communication must comply with the Electronic Communication with Student Policy.

Student Accessibility Services: The University of Manitoba is committed to providing an accessible academic community. *Students Accessibility Services (SAS)* offers academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation. Students are welcome to meet with the instructors to discuss the accommodations recommended by SAS.

Student Accessibility Services
`http://umanitoba.ca/student/saa/accessibility/`
520 University Centre
Phone: (204) 474–7423
Email: `Student_accessibility@umanitoba.ca`

Academic Integrity: You are expected to be academically honest. This means, for example, providing a list of the people (if any) with whom you worked and providing a list of sources other than the textbook (if any) that you used to complete an assignment. Although you are encouraged to work together, you should never submit anything that you do not understand or is not written in your own words. The following excerpt about Academic Honesty is taken from the Department of Mathematics web-page:

The Department of Mathematics, the Faculty of Science and the University of Manitoba regard acts of academic dishonesty in quizzes, tests, examinations or assignments as serious offenses and may assess a variety of penalties depending on the nature of the offense. Acts of academic dishonesty include bringing unauthorized materials into a test or exam, copying from another student, plagiarism and examination personation. Students are advised to read the sections entitled "Academic Integrity" and "Examination Personations" in the "General Academic Regulations and Requirements" section of the current Undergraduate Calendar.

Penalties for violation include being assigned a grade of zero on a test or assignment, being assigned a grade of "F" in a course, compulsory withdrawal from a course or program, suspension from a course/program/faculty or even expulsion from the University. For specific details about the nature of penalties that may be assessed upon conviction of an act of academic dishonesty, students are referred

to University Policy 1202 (*Student Discipline Bylaw*); and to the Department of Mathematics policy concerning minimum penalties for acts of academic dishonesty.

Students are encouraged to visit the University of Manitoba Academic Integrity site for further information.

Classroom Atmosphere: A part of learning is making mistakes. We want to establish a classroom atmosphere where the inevitable false starts and mistakes become an opportunity to improve – not an opportunity for embarrassment. Please be constructive and polite in questioning your colleagues.

Other Expectations and Tips for Success: I ask that you have a well-defined sense of professionalism, that you always put forth your best effort, and that you develop a sense of responsibility to your educational community. I ask that you exhibit a persistent desire to learn. In return I will provide you with significant support. Also:

- Be positive, open, and responsive to feedback.
- Be an active participant - mathematics is learned by doing; this includes participating fully in classroom activities (please, turn your cell phones off during class), completing the suggested exercises, critically thinking about the mathematics during and outside of class. *In order for this class to be successful, it is imperative that you commit to coming to class/tutorial sessions regularly, that you commit to coming to class/tutorial sessions prepared, and that you commit to participating in class/tutorial sessions!*
- Be/become a "risk taker".
- Be committed.
- Be patient with yourself - it takes time to master newly learned things. Ask for assistance when it is needed. Constantly try to improve yourself as a mathematician.
- Starting with the first class, study in-depth and regularly. This means, for example, that you should do the suggested exercises *before* the next class period.
- It is tempting to just copy available solutions. However, struggling through the exercises on your own is an important phase of the learning process.
- Get help as soon as you need it: ask questions in class and office hours; form a study group with your classmates; consider getting a tutor, etc.
- For examination preparation, practice exercises that have not been assigned.
- Save your solutions to suggested exercises to study from. You may find it helpful to organize your work in a 3-ring binder or notebook for your suggested exercises. You should be able to look at the solutions a month later and understand what is on the paper.
- Mathematics is a language in itself that is common to many sciences across the world. It is crucial that we all use consistent and correct notation. For example, when using the equal sign you should make sure that the quantities on either side of the equal sign are indeed equal.
- Take pride in your work and take your work seriously. This means you should: use complete sentences with proper grammar and correct spelling, write legibly, provide justification for your claims, show all of your work, clearly state all the hypotheses being used, etc.
- Like in all areas of life, constructive feedback can be difficult to digest and accept. Please know that the feedback provided in this course is meant to *improve* your mathematical solutions and communication. Please take the feedback seriously and apply it to your future work.
- Everyone wants you to succeed. Please speak with me regarding any concerns you may have.
- Relax and have fun with the course!