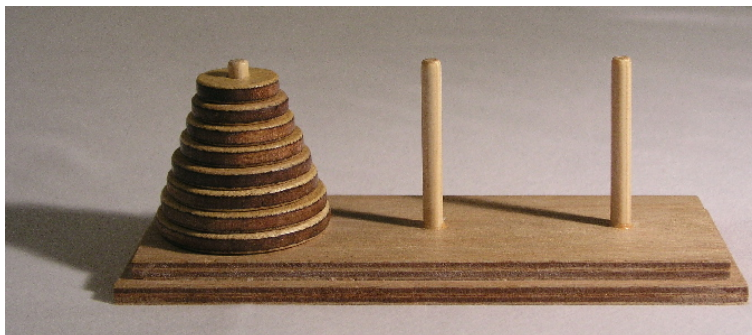# MATH 3120 A01: Applied Discrete Mathematics
Course Information Sheet and Syllabus
Fall 2019

BASIC COURSE DETAILS

Instructor: Dr. Susan Cooper

Class Times and Location: Tuesdays & Thursdays 10:00 – 11:15 a.m., 124 Machray Hall

Tutorial Times, Location and TA: *All tutorial sessions are held on Tuesdays.*

Time	Location	TA
11:30 a.m. – 12:45 p.m.	124 Machray Hall	Tessa Reimer (reimer46@myumanitoba.ca)

Credit Hours: 3

Pre-Requisites: ECE 2220 (C) and MATH 2130 (C).

Notes: MATH 3120

- is for Engineering students only;
- may not be held with COMP 2130.

INSTRUCTOR CONTACT INFORMATION

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

Office: Machray Hall, Room 476   **Office Phone:** (204) 474–9701

Office Hours: Tuesdays 3:30 – 4:30 p.m. & Wednesdays 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 Monday – Thursday; an email received Friday – Sunday will receive a reply the following Monday. *All appointments are to be made via email.*

COURSE DESCRIPTION AND GOALS

"The world is continuous, but the mind is discrete." — *David Mumford (ICM 2002 plenary talk)*

University of Manitoba Course Calendar Description: Sets, groups, graphs, and Boolean algebra.

General Course Description and Goals: Discrete Mathematics is a branch of mathematics that focuses on discrete rather than continuous structures. Examples of discrete structures include the integers and graphs in which we can study the distinct elements within the structure rather than the inherent nature of the structure itself. An example of a continuous structure is the real numbers in which we can consider the smoothly changing behaviour of the set via calculus. By studying the objects in a set as separate entities, we are able to investigate arrangements of the objects, relationships, enumeration properties of the set, and more.

One of the great advantages of studying mathematics is that it helps us develop the ability to handle abstract ideas. The topics often seen in discrete mathematics courses allow us to cultivate this ability with concrete examples, mathematical rigor, and beautiful applications. The study of discrete mathematics involves topics that are important branches of mathematics and engineering which are thriving and intriguing in their own right such as computer science, information theory, operations research, and software development (just to name a few!). As such, it is not surprising that discrete mathematics hosts many applications (including games such as the Tower of Hanoi illustrated on the first page; taken from `https://commons.wikimedia.org/wiki/File:Tower_of_Hanoi.jpeg`).

MATH 3120 is a one-term course that provides an introduction to applied discrete mathematics. We will consider numerous topics such as:

- Preliminaries: sets, binary relations, functions, summations, matrices, Greatest Common Divisors (GCDs);
- Logic: language of logic, quantifiers, advanced induction;
- Formal Logic: propositional calculus, Boolean algebra;
- Algorithms: pseudo-code language, recursive algorithms;
- Graph Theory: graphs, digraphs, paths, cycles, adjacency matrices, connectivity, trees, graph algorithms;
- Enumeration: permutations, combinations, inclusion/exclusion, Binomial Theorem, combinatorial identities, Pigeonhole Principle;
- Group Theory: groups, subgroups, cosets, Lagrange's Theorem, quotient groups;
- Difference Equations/Recurrence Relations: basic types of recurrences/difference equations and solution methods.

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 build a tool-set that can be applied in their future engineering courses and endeavours.

COURSE MATERIALS

Textbook: *Discrete and Algorithmic Math: Notes for MATH 3120* by R. Craigen. Students will be provided with a copy of the notes.

Optional Reference: *Discrete Algorithmic Mathematics*, 3rd ed., by S Maurer and A. Ralston

Course Web-Page: We will use UM Learn and the instructor's web-page which can be found at
`http://server.math.umanitoba.ca/~coopers5/courses_umanitoba/math3120_f19.html`

ASSESSMENTS AND COURSE GRADES

Problem Sets and Readings: Mathematics is not a spectator sport. The best way to learn mathematics is by doing mathematics! To encourage constant engagement, a collection of exercises and readings will be assigned and collected on a weekly basis. Problem Sets will be distributed in the Tuesday tutorial. When there is not an exam scheduled, you will be given time in the tutorial to work on the Problem Set with fellow classmates and the opportunity to seek assistance from the teaching assistant. Each Problem Set is due by 10:00 a.m. on the Thursday of the same week the assignment is distributed. You may submit your solutions either at the beginning of class or to the Department of Mathematics (*with date and time of submission noted*). Late submissions will not be accepted. However, you can always submit an assignment before the deadline. A subset of the solutions will be graded based on correctness, completeness, and quality of exposition (clarity, style/creativity, conciseness, etc.). Partial credit will be awarded whenever possible. Any necessary special grading rules will be provided beforehand. Moreover, students will receive ample feedback before the Voluntary Withdrawal Deadline – in general, a graded Problem Set will be returned the week after it being submitted. Please note that all feedback is meant to *improve* your mathematical abilities and communication. It is highly recommended that you carefully read the material and complete all the exercises in a Problem Set in order to keep on track and make sure that you have solid foundations before moving on to the next topic. The Problem Sets are intended to gauge your understanding of the material while presenting opportunities for you to practice the fine art of communicating mathematics.

In many areas of life, we deepen our understanding via discussions with others and a variety of resources. Although you are encouraged to work together on Problem Sets and to discuss ideas with myself, you are expected to submit solutions that are written individually and in your own words: see the section entitled "Academic Integrity" and the handout entitled "Guidelines for Problem Sets" for further expectations and more information.

Examinations: There will be two 75-minute term tests and one 3-hour cumulative final examination administered in MATH 3120. The schedule is:

Examination	Date	Time and Location
Term Test I	Tuesday, October 8	11:30 a.m. – 12:45 p.m., 124 Machray Hall (in Tutorial)
Term Test II	Tuesday, November 5	10 – 11:15 a.m., 124 Machray Hall (in class)
Final Exam	In December – TBA	TBA (set by U of M Registrar)

Calculators and/or reference material (including electronic devices) will **not** be allowed on the tests 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 two tests and is meant to improve your mathematical abilities and communication. Grades and feedback for Term Test I and grades for Term Test II will be provided prior to the Voluntary Withdrawal Deadline.

Class Attendance and Participation: Your understanding of the course material will be greatly supported by regular attendance and engagement in class meetings. Although you are expected to attend every class 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 exercises from the Problem Sets. 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 and Letter Grades: Final course grades will be determined as follows:

Task	Percentage of Grade
Problem Sets	10% (best 9 out of 11)
Term Test I	20%
Term Test II	20%
Final Examination	50%

Below are the minimum cut-off ranges for grades; these may decrease at the instructors' discretion.

Letter Grade	Percentage Out Of 100	Final Grade Point Value
A+	95–100	4.5
A	85–94	4.0
B+	78–84	3.5
B	72–77	3.0
C+	66–71	2.5
C	60–65	2.0
D	50–59	1.0
F	Less than 50	0

Deferred Work: Late Problem Set submissions will not be accepted for any reason. Also, there will be no deferred term tests for any reason. If you miss a term test, you will be assigned a mark of "zero" unless there is an unavoidable, documented circumstance 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

In that case the weight of the term test will be re-assigned to the final examination. Students who miss a term test and wish to request a re-weighing to the final examination must contact the instructor within 48 hours of the start time of the test (initial email contact is sufficient). Please note that recreational activities do not qualify as an unavoidable circumstance. 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

COURSE SCHEDULE AND IMPORTANT DATES

The topics schedule below is subject to change at the discretion of the instructor and/or based on learning needs of the students (subject to Section 2.8 of Responsibilities Of Academic Staff With Regard To Students). Assessment dates will not change.

Dates	Topic	Problem Set Due
Sept. 4–6	Preliminaries Chapter 1 (MR §0.1–0.5)	
Sept. 9–13	Preliminaries, Logic Chapters 1, 2 (MR §0.1–0.6)	# 1 Sept. 12
Sept. 16–20	Logic Chapter 2 (MR §0.6)	# 2 Sept. 19
Sept. 23–27	Formal Logic, Boolean Algebra Chapters 3, 9 (MR §7.1–7.3, 7.5)	# 3 Sept. 26
Sept. 30–Oct. 4	Algorithms, Graph Theory Chapters 4, 5 (MR §1.1–1.3, 2.1–2.4, 2.7, 2.8, 3.1–3.5, 3.7)	# 4 Oct. 3
Oct. 7–11	Graph Theory Chapter 5 (MR §3.1–3.5, 3.7)	
Term Test I: Tuesday, October 8 (in tutorial session)		
No Classes: Monday, October 14 (Thanksgiving Day)		
Oct. 14–18	Graph Theory Chapter 5 (MR §3.1–3.5, 3.7)	# 5 Oct. 17
Oct. 21–25	Graph Theory, Enumeration Chapters 5, 6 (MR §3.1–3.5, 3.7, 4.1–4.6, 4.10)	# 6 Oct. 24
Oct. 28–Nov. 1	Enumeration Chapter 6 (MR §4.1–4.6, 4.10)	# 7 Oct. 31
Nov. 4–8	Enumeration, Group Theory Chapters 6, 7 (MR §4.1–4.6, 4.10)	# 8 Nov. 7
Term Test II: Tuesday, November 5 (in class)		
No Classes: November 11–15 (Remembrance Day & Fall Term Break)		
Voluntary Withdrawal Deadline: Monday, November 18		
Nov. 18–22	Group Theory Chapter 7	# 9 Nov. 21
Nov. 25–29	Group Theory Chapter 7	# 10 Nov. 28
Dec. 2–6	Group Theory, Difference Equations Chapter 7 (MR §5.1–5.7)	# 11 Dec. 5
Final Examination: Date, Time, Location To Be Determined By U of M Registrar		

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).

FIPPA STATEMENT OF PURPOSE: CROWDMARK

We may use the platform *Crowdmark* in order to assess quizzes and examinations. In such instances, your personal information is being collected under the authority of The University of Manitoba Act. It will be used for the purposes of grading papers and providing feedback to students. Personal information will not be used or disclosed for other purposes, unless permitted by The Freedom of Information and Protection of Privacy Act (FIPPA). The University of Manitoba has taken steps to ensure that its agreement with Crowdmark, Inc. for services provided by the Crowdmark application is in compliance with FIPPA. Please be aware that information held by Crowdmark Inc. may be transmitted to and stored on servers outside of the University of Manitoba, or Canada. The University of Manitoba cannot and does not guarantee protection against the possible disclosure of your data including, without limitation, against possible secret disclosures of data to a foreign authority in accordance with the laws of another jurisdiction. If you have any questions about the collection of personal information, contact the Access and Privacy Office (tel. (204) 474–9462), The University of Manitoba, 233 Elizabeth Dafoe Library, Winnipeg, Manitoba, Canada, R3T 2N2.

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 Problem Sets and examinations, 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 Students 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 instructor to discuss the accommodations recommended by SAS.

Student Accessibility Services
http://umanitoba.ca/student-supports/accessibility
520 University Centre
Phone: (204) 474–7423
Email: Student_accessibility@umantioba.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 offences and may assess a variety of penalties depending on the nature of the offence. 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 "Final Examinations" (in particular, the section "Examination Personations") in the "General Academic Regulations" 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. Information regarding Academic Integrity is also available from the Faculty of Science web-page.

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 Problem Sets, 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 attending class/tutorial sessions regularly, that you commit to preparing beforehand for class meetings, and that you commit to participating in class meetings!*
- 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.
- 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; read alternate resources.
- For examination preparation, practice exercises that have not been assigned.
- 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!