

Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 4360
Combinatorial Modelling
Winter 2020

Instructor(s): Jason I. Brown jason.brown@dal.ca Chase 204

Lectures: TR 10:05 – 11:25 CS 127

Laboratories: 0

Tutorials: 0

Course Description

This course introduces a common framework for combinatorial structures (graphs, digraphs, hypergraphs, posets, preorders, lattices, finite topologies, simplicial complexes), with an emphasis on how to model these structures with other fields of mathematics, such as matrix theory and linear algebra, commutative algebra, topology, analysis, probability and logic.

Course Prerequisites

A passing grade in MATH 1000.03.

Course Objectives/Learning Outcomes

This course an introduction to mathematical modelling.

Objective: “The student will be able to identify different types of discrete structures”

Condition: Given a discrete structure.

Behaviour: The student will be able to identify the type of discrete structures provided.

Objective: “The student will be able to identify isomorphic discrete structures”

Condition: Given two discrete structure.

Behaviour: The student will be able to apply the definition of isomorphism to decied whether the two structures are isomorphic.

Objective: “The student will be able to model a discrete structure geometrically”

Condition: Given a discrete structure.

Behaviour: Base on the structure, the student will be able to provide at least one geometric representation of the structure.

Objective: “The student will be able to model a discrete structure algebraically”

Condition: Given a discrete structure.

Behaviour: Base on the structure, the student will be able to provide at least one algebraic representation of the structure.

Objective: "The student will be able to model a discrete structure logically"

Condition: Given a discrete structure.

Behaviour: Base on the structure, the student will be able to model the structure in first order logic.

Objective: "The student will be able to model a discrete structure probabilistically"

Condition: Given a discrete structure.

Behaviour: Base on the structure, the student will be able to provide, where appropriate and available, a probabilistic model of the structure.

Objective: "The student will be able to solve problems on graph colourings."

Condition: Given a graph theoretic problem involving colourings.

Behaviour: The student will be able to provide colourings or bounds on the number colours required.

Objective: "The student will be able to solve problems on network reliability."

Condition: Given a graph.

Behaviour: The student will be able to calculate the all-terminal reliability of the graph.

Objective: "The student will be able to appreciate and reproduce applications of topology, algebra, analysis, logic and probability to graph theoretic problems."

Condition: Given an appropriate problem stated only in terms of graph theory.

Behaviour: The student will be able to apply a variety of techniques from point-set topology, linear algebra, analysis, first-order logic and probability theory to provide the required proof.

Objective: "The student will be able to manipulate posets and preorders."

Condition: Given a poset or preorder.

Behaviour: The student will be able to carry out various calculations on the poset or preorder.

Objective: "The student will be able to work with finite topologies as preorders."

Condition: Given a finite topology.

Behaviour: The student will be able to model the finite topology as a preorder.

Objective: "The student will be able to model mathematical problems with hypergraphs."

Condition: Given an appropriate mathematical problem.

Behaviour: The student will be use hypergraphs to solve the problem.

Objective: "The student will learn to work with complexes and matroids."

Condition: Given a mathematical problem.

Behaviour: The student will be able to use complexes and matroids to model various combinatorial problems.

Objective: "The student will learn to apply complexes and order ideals of monomials."

Condition: Given a graph colouring or network reliability problem.

Behaviour: The student will be able to use complexes and order ideals of monomials to provide new insights into the problems.

Course Materials

Textbook: Discrete Structures and Their Applications by J.I. Brown, Brooks/Cole, CRC Press, 2013.

Course website: The course website is on Brightspace.

Course Assessment

Component	Weight (% of final grade)	Date
<i>Tests</i>	40%	Tuesday, February 11, 2020 and Thursday, March 19, 2020
<i>Assignments</i>	30%	
<i>Project</i>	30%	(Scheduled by Registrar)

Other course requirements

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D	(50-54)
A (85-89)	B (73-76)	C (60-64)	F	(<50)
A- (80-84)	B- (70-72)	C- (55-59)		

Course Policies

No late assignments will be accepted. If you miss a midterm, assignment or tutorial, you are required to fill out and submit the Student Self-Declaration of Absence form online in Brightspace. In the case of a missed assignment or tutorial attendance, the missed assignment or tutorial attendance score will not be included in the average for that component, if a Student Self-Declaration of Absence form is submitted within six (6) days of the missed due date. In the absence of a Self-Declaration of Absence, the missed assignment/tutorial will receive a grade of zero. For a missed midterm, you must contact the instructor at jason.brown@dal.ca on or before the scheduled date of the midterm, and submit a copy of your academic schedule, so that a make-up midterm can be scheduled. If you are unable to attend the make-up midterm, and submit a second Student Self-Declaration of Absence form, the weight of the midterm will be added to the final exam.

All assignments are to be completed independently; no group assignments are allowed.

Course Content

- 1) Discrete Structures – A Common Framework
 - a) Isomorphism
 - b) Substructures
 - c) Properties, Parameters and Operations
 - d) Representations and Models
 - 2) Graphs and Directed Graphs
 - a) Graphs and Directed Graphs as Models
 - b) Graphs and Other Branches of Mathematics
 - 3) Preorders and Partial Orders
 - a) Finite Topologies and Preorders
 - b) Representing Preorders and Partial Orders
 - 4) Hypergraphs
 - a) Applying Hypergraphs
 - b) Modeling Hypergraphs
 - 5) Complexes and Multicomplexes
 - a) Representations of Complexes and Multicomplexes
 - b) Applications of Complexes and Multicomplexes
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University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

https://www.dal.ca/academics/important_dates.html

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

Student Resources and Support**Advising**

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>