DALHOUSIE UNIVERSITY

Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 4370
Combinatorics
Winter 2018

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

Lectures: TR 13:05 – 14:25 LSC-Oceanography O3

Laboratories: 0

Tutorials: 0

Submit course syllabus to your Department office for posting on the Dept website prior to the start of term
Submit requests for final exam exemptions (1000, 2000 and 3000 level courses only) to the Dean's office at least 2 weeks prior to the start of term

Course Description

This course will cover the important concepts of combinatorics: Counting techniques including combinations and permutations, the pigeonhole principle, inclusion/exclusion, recurrence relations, generating functions and power series. Structures include partial orders, set systems and transversals, Steiner triple systems and an introduction to designs, and finite geometries.

Course Prerequisites

A passing grade in at least one of MATH 2112.03, MATH 2051.03, MATH 3070.03 or MATH 3330.03, or permission of the Instructor.

Course Objectives/Learning Outcomes

This course presents the theory, application and algorithms relevant to solving linear programing problems.

Objective: "Given a simple counting problem, the student will be able to compute the number of events using binomial coefficients and factorials."
Condition: Given a counting problem.
Behaviour: The student will be able to calculate the number of corresponding events.

Objective: "Given an advanced counting problem, the student will be able to generate a recurrence relation."
Condition: Given a counting problem that can be described recursively.
Behaviour: The student will be able to formulate the appropriate recursion.

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Objective: “Given a homogeneous recurrence relation the student will be able solve the relation using the characteristic function.”

Condition: Given a homogeneous recurrence relation.

Behaviour: The student will be able to solve the recurrence relation using algebraic techniques.

Objective: “Given a simple, general recurrence relation the student will be able to compute the explicit formula using power series or generating functions.”

Condition: Given a simple recurrence relation.

Behaviour: The student will be able to solve the recurrence using power series/generating functions.

Objective: “The student will be able to recognize a matching problem.”

Condition: Given a word problem.

Behaviour: The student will be able to determine whether it can be formulated as a matching problem.

Objective: “The student will be able to compute a maximum stable matching.”

Condition: Given a bipartite graph.

Behaviour: The student will be able to find a maximum stable matching.

Objective: “The student will be able to generate mutually orthogonal latin squares.”

Condition: Given a positive integer n.

Behaviour: The student will be able to produce mutually orthogonal latin squares of side n.

Objective: “The student will be able to use mutually orthogonal latin squares to generate knight’s tours.”

Condition: Given a set of mutually orthogonal latin squares.

Behaviour: The student will be able utilize these to create a knight’s tour.

Objective: “The student will be able to use mutually orthogonal latin squares to magic squares.”

Condition: Given mutually orthogonal latin squares.

Behaviour: The student will be able to find magic squares.

Objective: “The student will be able to construct difference sets.”

Condition: Given a positive integer n.

Behaviour: The student will be able to create a difference set mod n.

Objective: “The student will be able to use difference sets to generate Steiner triple systems.”

Condition: Given a difference set.

Behaviour: The student will be able to utilize the difference set to create a Steiner triple system.

Objective: “The student will be able to use difference sets to generate designs.”

Condition: Given a difference set.
Behaviour: The students will be able to utilize the difference set to create design.

Objective: "The student will be able to apply Burnside's Lemma to count objects with many symmetries."
Condition: Give an object with possible symmetries.
Behaviour: The students will be able to use Burnside's Lemma to count the number of symmetries.

Course Materials

Textbook: Introductory Combinatorics. Richard A. Brualdi, Pearson/Prentice Hall, 5th edition, 2010.
Other readings will be made available on the course website.

Course Assessment

Component	Weight (% of final grade)	Date
Tests/quizzes	30%	Thursday, November 8, 2018
Final exam	20%	Tuesday, December 4, 2018 (in class),
	20%	Tuesday, December 11, 2018 (take-home)
Assignments	30%	(to be scheduled)

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 an assignment or the midterm exam, a score of 0 will be assigned unless you fill out the Student Self-Declaration of Absence form online in Brightspace. For a missed midterm, you must contact the instructor at jason.brown@dal.ca on the scheduled date of the midterm, along with your schedule so that a make-up midterm can be scheduled. All students who miss the midterm must write the make-up midterm.

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

Course Content

Counting

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Permutations and Combinations
Pigeonhole Principle

Equivalence Relations and Partial Orders

Inclusion-Exclusion Principle

Recurrence Relations and generating functions

Matchings
Systems of distinct representatives
Stable marriages

Designs
Steiner triple systems
Block designs
Finite projective geometries
Latin squares and mutually orthogonal latin squares

Burnside's Lemma
Polya's Theory of Counting

ACCOMMODATION POLICY FOR STUDENTS

Students may request accommodation as a result of barriers related to disability, religious obligation, or any characteristic protected under Canadian Human Rights legislation. The full text of Dalhousie's Student Accommodation Policy can be accessed here: http://www.dal.ca/dept/university_secretariat/policies/academic/student-accommodation-policy-wef-sep--1--2014.html

Students who require accommodation for classroom participation or the writing of tests and exams should make their request to the **Advising and Access Services Centre (AASC)** prior to or at the outset of the regular academic year. More information and the ***Request for Accommodation*** form are available at www.dal.ca/access.

ACADEMIC INTEGRITY

Academic integrity, with its embodied values, is seen as a foundation of Dalhousie University. It is the responsibility of all students to be familiar with behaviours and practices associated with academic integrity. Instructors are required to forward any suspected cases of plagiarism or other forms of academic cheating to the Academic Integrity Officer for their Faculty.

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The Academic Integrity website (http://academicintegrity.dal.ca) provides students and faculty with information on plagiarism and other forms of academic dishonesty, and has resources to help students succeed honestly. The full text of Dalhousie's ***Policy on Intellectual Honesty*** and ***Faculty Discipline Procedures*** is available here:

http://www.dal.ca/dept/university_secretariat/academic-integrity/academic-policies.html

STUDENT CODE OF CONDUCT

Dalhousie University has a student code of conduct, and it is expected that students will adhere to the code during their participation in lectures and other activities associated with this course. In general:

"The University treats students as adults free to organize their own personal lives, behaviour and associations subject only to the law, and to University regulations that are necessary to protect

- the integrity and proper functioning of the academic and non – academic programs and activities of the University or its faculties, schools or departments;
- the peaceful and safe enjoyment of University facilities by other members of the University and the public;
- the freedom of members of the University to participate reasonably in the programs of the University and in activities on the University's premises;
- the property of the University or its members."

The full text of the code can be found here:
http://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html