Faculty of Science Course Syllabus
Department of Mathematics and Statistics
MATH 4331/5331
Topics in Combinatorics

Dalhousie University acknowledges that we are in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq People and pays respect to the Indigenous knowledges held by the Mi'kmaq People, and to the wisdom of their Elders past and present. The Mi'kmaq People signed Peace and Friendship Treaties with the Crown, and section 35 of the Constitution Act, 1982 recognizes and affirms Aboriginal and Treaty rights. We are all Treaty people.

Dalhousie University also acknowledges the histories, contributions, and legacies of African Nova Scotians, who have been here for over 400 years.

Course Instructor

	Name	Email address	Office Hours
Instructor	Jeannette Janssen	jeannette.janssen@dal.ca	TBA in Chase 315

Course Description

Calendar Entry

This course will cover current research in combinatorics. Selected topics may include: graph polynomials, simplicial complexes, partial orders, enumeration problems, and algebraic methods in combinatorics.

Course Description Fall 2024

This is a topics course. The aim is to present topics in combinatorics that are at the forefront of current research. This term, the topic of the course is algebraic and spectral graph theory. This is the study of graphs through their adjacency matrix and, in particular, the eigenvalues (spectrum) of this matrix. We will see how the spectrum of matrices associated with graphs reveals structural properties of the graphs. We will also see important applications to diffusion in graphs, graph clustering, and visualization of graphs.

Course Delivery

Lectures

In person (not recorded).

Days	Time	Location
MWF	11.35 AM – 12:25 PM	Chase 319

Format

This is a seminar course. Classes will be in-person. Class attendance is important and mandatory, and student participation and involvement is encouraged. An important aspect of the course are the assignments and study tasks. Study tasks are short, straightforward assignments where students have to apply the concepts learned in class. Assignments are longer, and answers should be given as formal mathematical arguments. There will also be a final project. There are no exams.

Course Materials

We will be following two sets of notes on spectral and algebraic graph theory. In addition, instructor's notes will be made available. Additional material will be posted as needed. All material will be posted on Brightspace.

- Principal text: Spectral and Algebraic Graph Theory (Incomplete draft) Daniel Spielman, Yale university. Available at http://cs-www.cs.yale.edu/homes/spielman/sagt/sagt.pdf.

- Supporting text: Spectra of Graphs, Andries E. Brouwer and Willem H. Haemers, Springer, 2012. ISBN 9781489994332.

Evaluation and course policy

The assessment of your performance in the course will be based on assignments, a final project, and completion of the study tasks.

Study tasks

Study tasks will be assigned in (almost) every class. Study tasks need to be uploaded to Brightspace by the deadline (usually the next class). The work will be marked *Pass/Fail*: any reasonable attempt will get a pass. Study tasks will be discussed in class; MATH 5331 students will take turns presenting their solution. No credit will be given for study tasks submitted past the deadline. Students who are unable to submit their solution to a study task with a valid reason must submit a Student Declaration of Absence (SDA) form before the deadline of the study task. In such cases, the missed study task will be discounted, and the mark will be taken out of the remaining study tasks. This rule can apply to at most two study tasks during the term; any further missed study tasks will be marked as Fail.

Assignments

The evaluation of this course is based in large part on the assignments. Assignments may go slightly beyond the material presented in class, to encourage students to consult the course texts and to think about the material. Students are encouraged to discuss the assignments with their class mates. However, the final solutions must be written individually by each student. Any material consulted must be properly credited; this includes web pages, or personal communication. Assignment problems may differ for students taking this class as MATH 4331 or MATH 5331, to account for the difference in credit. There will be an extra assignment near the end of the course for MATH 4331 students only.

The answers should be in pdf format. They may be handwritten and scanned, or typed. Make sure your submission is legible and correctly scaled and oriented. Students will be asked to resubmit any solutions that are hard to read, and the late penalty will apply. Assignment solutions submitted up to 8 days after the deadline will be accepted, but will incur a penalty. The penalty for late submission is 5% if within 24 hours of the deadline, and 15% otherwise. Solutions submitted more than 8 days after the deadline will be marked as zero.

Students that are unable to complete and submit an assignment before the deadline for a valid reason will not incur the penalty. To qualify, students must submit an SDA form before the deadline. The students will still have to submit the assignment, with a deadline to be determined by the instructor in consultation with the student. Student may miss no more than one assignment under this rule. The penalties will apply to any additional assignments late or missed.

Project

MATH 5331 students will be expected to do a project that consists of reading, understanding and summarizing a scientific paper which presents recent research in algebraic and spectral graph theory. Students will give a short (20 minute) presentation on their topic, and produce a report of 8–10 pages. MATH 4331 students need to do a mini-project that consists of reading and understanding a short section out of a text book. Students should explain the material in this section at a level appropriate for their class mates, and add examples. Students will give a 10 minute presentation.

Assessment

MATH 4331	
Component	**Weight (% of final grade)**
Assignments	65%
Study tasks	15%
Project	20%
MATH 5331	
Component	**Weight (% of final grade)**
Assignments	55%
Study tasks	20%
Project	25%

Conversion of numerical grades to final letter grades follows the Dalhousie Grade Scale.

A+:	(90–100)	A:	(85–89)	A-:	(80–84)
B+:	(77–79)	B:	(73–76)	B-:	(70–72)
C+:	(65–69)	C:	(60–64)	C-:	(55–59)
D:	(50–54)	F:	(0–49)		

Course Policies related to Academic Integrity

- Students are permitted to discuss the assignments with classmates, but the final version of the solution must be done individually.

- Any material consulted for the assignment and the project must be properly credited; this includes web pages, or personal communication.

Learning Objectives

- To learn the fundamental concepts of a specific topic of combinatorics.

- To become familiar with the properties of the matrices associated with graphs: adjacency matrix, Laplacian, and normalized Laplacian.

- To learn how to interpret properties of graph matrices in terms of properties of the graphs.

- To be able to read a formal exposition of a mathematical result involving algebraic or spectral graph theory, understand it, fill in the details, and discuss it.

- (MATH 5331) To be able to read and understand a scientific paper where methods from linear algebra and graph theory are used.

University Policies and Statements

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 at 1321 Edward St or elders@dal.ca. Additional information regarding the Indigenous Student Centre can be found at: https://www.dal.ca/campus_life/communities/indigenous.html

Internationalization

At Dalhousie, 'thinking and acting globally' enhances the quality and impact of education, supporting learning that is "interdisciplinary, cross-cultural, global in reach, and orientated toward solving problems that extend across national borders." Additional internationalization information can be found at: https://www.dal.ca/about-dal/internationalization.html

Academic Integrity

At Dalhousie University, we are guided in all our work by the values of academic integrity: honesty, trust, fairness, responsibility, and respect. As a student, you are required to demonstrate these values in all 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. Additional academic integrity information can be found at: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Student Accessibility Centre is Dalhousie's centre of expertise for matters related to student accessibility and accommodation. If there are aspects of the design, instruction, and/or experiences within this course (online or in-person) that result in barriers to your inclusion, please contact the Student Accessibility Centre (https://www.dal.ca/campus_life/academic-support/accessibility.html) for all courses offered by Dalhousie with the exception of Truro. For courses offered by the Faculty of Agriculture, please contact the Student Success Centre in Truro (https://www.dal.ca/about-dal/agricultural-campus/student-success-centre.html)

Conduct in the Classroom - Culture of Respect

Substantial and constructive dialogue on challenging issues is an important part of academic inquiry and exchange. It requires willingness to listen and tolerance of opposing points of view. Consideration of individual differences and alternative viewpoints is required of all class members, towards each other, towards instructors, and towards guest speakers. While expressions of differing perspectives are welcome and encouraged, the words and language used should remain within acceptable bounds of civility and respect.

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 (Strategic Priority 5.2). Additional diversity and inclusion information can be found at: http://www.dal.ca/cultureofrespect.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. The full Code of Student Conduct can be found at: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Fair Dealing Policy

The Dalhousie University Fair Dealing Policy provides guidance for the limited use of copyright protected material without the risk of infringement and without having to seek the permission of copyright owners. It is intended to provide a balance between the rights of creators and the rights of users at Dalhousie. Additional information regarding the Fair Dealing Policy can be found at: https://www.dal.ca/dept/university_secretariat/policies/academic/fair-dealing-policy-.html

Originality Checking Software

The course instructor may use Dalhousie's approved originality checking software and Google to check the originality of any work submitted for credit, in accordance with the Student Submission of Assignments and Use of Originality Checking Software Policy. Students are free, without penalty of grade, to choose an alternative method of attesting to the authenticity of their work and must inform the instructor no later than the last day to add/drop classes of their intent to choose an alternate method. Additional information regarding Originality Checking Software can be found at:
https://www.dal.ca/dept/university_secretariat/policies/academic/student-submission-of-assignments-and-use-of-html

Student Use of Course Materials

Course materials are designed for use as part of this course at Dalhousie University and are the property of the instructor unless otherwise stated. Third party copyrighted materials (such as books, journal articles, music, videos, etc.) have either been licensed for use in this course or fall under an exception or limitation in Canadian Copyright law. Copying this course material for distribution (e.g. uploading to a commercial third-party website) may lead to a violation of Copyright law.

Student Resources and Support

University Policies and Programs

Important Dates in the Academic Year (including add/drop dates): http://www.dal.ca/academics/important_dates.html

Classroom Recording Protocol: https://www.dal.ca/dept/university_secretariat/policies/academic/classroom-recording-html

Dalhousie Grading Practices Policies: https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practi-html

Grade Appeal Process: https://www.dal.ca/campus_life/academic-support/grades-and-student-records/appealing-a-grad-html

Sexualized Violence Policy: https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-vio-html

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

Learning and Support Resources

General Academic Support - Advising (Halifax): https://www.dal.ca/campus_life/academic-support/advising.html

General Academic Support - Advising (Truro): https://www.dal.ca/about-dal/agricultural-campus/ssc/academic-support/advising.html

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

On Track (helps you transition into university, and supports you through your first year at Dalhousie and beyond): https://www.dal.ca/campus_life/academic-support/On-track.html

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

Indigenous Connection: https://www.dal.ca/about-dal/indigenous-connection.html

Elders-in-Residence (The Elders in Residence program provides students with access to First Nations elders for guidance, counsel, and support. Visit the office in the Indigenous Student Centre or contact the program at elders@dal.ca or 902-494-6803: https://cdn.dal.ca/content/dam/dalhousie/pdf/academics/UG/indigenous-studies/Elder-Protocol-July2018.pdf

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

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

South House Sexual and Gender Resource Centre: https://southhousehalifax.ca/about/

LGBTQ2SIA+ Collaborative: https://www.dal.ca/dept/vpei/edia/education/community-specific-spaces/LGBTQ2SIA-colla html

Dalhousie Libraries: http://libraries.dal.ca/

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

Dalhousie Student Advocacy Services: https://www.dsu.ca/dsas?rq=student%20advocacy

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

Human Rights and Equity Services: https://www.dal.ca/dept/hres.html

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

Study Skills/Tutoring: http://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Faculty of Science Advising Support: https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html

Safety

Biosafety: http://www.dal.ca/dept/safety/programs-services/biosafety.html

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

Radiation Safety: http://www.dal.ca/dept/safety/programs-services/radiation-safety.html

Laser Safety: https://www.dal.ca/dept/safety/programs-services/radiation-safety/laser-safety.html