Faculty of Science Course Syllabus
Department of Mathematics and Statistics
CSCI / MATH - 2113: Discrete Structures (II)
Winter 2025

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 knowledge 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.

ALL TIMES MENTIONED ARE IN HALIFAX TIME

INSTRUCTOR: Hasan Mahmood
Course Code: MATH-2113 or CSCI-2113
LECTURES: **On Campus**
Day & Time: M W F @ 02:35PM-03:25PM
Venue: Studley LSC-COMMON AREA C238
OFFICE HOURS: T R @ 10:00AM-:11:00AM (Chase 212)
 (or by appointment)
Email: mh290120@dal.ca
Web: Dalhousie's Brightspcae

Prerequisite. MATH 1315.03 or MATH 2110.03 or MATH 2112.03

Course Description. This course is designed to enhance logical reasoning skills essential for computer science and mathematics. It introduces elementary counting techniques, advancing to more refined combinatorial methods like bijective counting and discrete probability. Key structures such as partitions, permutations, symmetry groups, graphs, and trees are explored. The course concludes by applying discrete principles to the computation, transmission, and error correction of digital information.

Textbook. Ralph P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*, 5th ed., Pearson, 2013. Chapters: 5-13.

Grading Scale.
    Participation – 2% (class participation)
    Homework – 30%
    Midterms – 30% (15% each)
    Final Exam – 40%

Exams.
    Midterm - I – February 05, 2025 (in-class)
    Midterm - II – March 07, 2025 (in-class)
    Final Exam – In April, (in-person). Date, time and Venue for the final exam will be conveyed soon.

Weekly Homework. Weekly homework assignments will be posted on Brightspace, and you are required to upload the completed assignments there by the specified due date. Submissions must be in a single PDF file, with each question starting on a new page and arranged in the correct order. Submissions that do not follow these formatting guidelines may be returned for revision, and points may be deducted.

Makeups - Homework. The lowest homework score will be dropped; therefore, no extensions or makeups will be granted for homework unless supported by proper documentation in accordance with Dalhousie University regulations.

Makeup - midterm. There will be no make-up examination for the midterm. If you are unable to participate in any midterm examination, its weight will be transferred to your final exam score, subject to the submission of proper documentation if required

Attendance. Students are advised and encouraged to attend all the classes.

Class Lecture Notes. Lecture notes will be made available on Brightspace after each lecture. These notes may be extracted from various books and can be relied upon as a useful resource. Additionally, there will be assigned reading tasks, with links and notes provided on Brightspace.

Email Correspondence. All email correspondence relating to our course should be sent to mh290120@dal.ca (must include CSCI/MATH-2113 in subject line to guarantee response, allow 24 working hours for response).

Course Policies related to Academic Integrity. Students are encouraged to collaborate with their peers when learning and reviewing topics. However, each student will need to submit their own work and must work independently on each of their assessments (assignments, midterms and final exam).

Important Dates. Please refer to this link for important dates for the Winter Semester 2025.

Learning Objectives.

- Be able to count combinatorial objects using elementary techniques.
- Become familiar with recurrence relations and know what it means to solve a recurrence relation.
- Know some basic recurrence relations such as the Fibonacci sequence and its recurrence relation.
- Become familiar with generating series and functions.
- Use generating series and generating functions to solve recurrence relations.
- Understand discrete probability spaces and random variables. Be able to compute the expected value of a discrete random variable by expressing it as a sum of relevant indicator variables and using linearity of expectation.
- Know the definition of divisibility for the integers and what it means for two integers to be congruent modulo a number n.
- Know how to perform arithmetic modulo n and calculate residues with the Extended Euclidean Algorithm.
- Know the statement of the Chinese Remainder Theorem and its use.
- Know the definition of simple graphs and trees. Be able to provide examples of each and separating examples.
- Be able to distinguish between forests and trees.
- Be able to discuss paths in graphs.
- Know how to find spanning trees of graphs and be able to determine uniqueness and non-uniqueness of paths in graphs.
- Know the difference between directed graphs and simple graphs.

- Know Dijkstra's algorithm and how to use it.
- Know the definition of finite state machines.
- Be able to represent finite state machines as both algebraic information and directed graphs.
- Know the basic concepts of error-correction in binary channels. Be able to encode and decode messages with a linear code. Be able to construct Hamming codes.
- Be able to distinguish between countable and uncountable sets. Know Cantor's diagonalization argument.

Additional Resources. If you are experiencing difficulty with the course material, please don't hesitate to reach out to me. Attend my office hours, and we can work through the challenges together. However, I encourage you to seek help sooner rather than later to ensure you stay on track.

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

Letter Grade	Percentage Range
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	(< 50)

CSCI/MATH-2113 Schedule (tentative)

Book: Ralph P. Grimaldi, *Discrete and Combinatorial Mathematics: An Applied Introduction*
(Lecture Notes will also be available on Brightspace)

Week of	Topics
January 06	Basic Counting Techniques; Combinatorial Proofs
January 13	Pigeonhole Principle; Inclusion-exclusion Principle
January 20	Relations: Partial Order and Equivalence Relation; Functions
January 27	Graphs, Forests, and Trees: Definitions and Basic Properties.
Midterm week: February 05, 2025 (In-class Midterm)	
February 03	Countable and Uncountable Sets
	The university will be closed on February 7, 2025, in observance of Munro Day
February 10	Sequences and recurrence relations
February 17	**Winter Break Week**
February 24	Generating Functions; Basic Congruence Theory, and CRT
Midterm week: March 07, 2025 (In-class Midterm)	
March 03	Discrete Probability Theory: Basic Concepts
March 10	Expectation; Tree Diagram; Discrete Random Variable
March 17	Cliques and Expectation; groups
March 24	Introduction to Coding Theory: Linear Codes, Hamming Codes
March 31	Basic Introduction to Information Theory; Review or "Catch-up"
Course ends on April 07, 2025.	
Important Note: The in-person Final Exam will be held in April, the exact date is TBD.	

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-originality-checking-software-policy.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-protocol.html`

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

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

- Sexualized Violence Policy: `https://www.dal.ca/dept/university_secretariat/policies/health-and-safety/sexualized-violence-policy.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 (help 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-collaborative.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