COMP/MATH 339
Combinatorics
Department of Computer Science and Software Engineering
Fall 2024

Course Instructor:
Hovhannes Harutyunyan
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Office Hours:
Tuesday, Thursday 11:40 – 12:10 in ER 1133

Lectures:
Tuesday/Thursday 10:15 – 11:30 room FG C-080

Tutorials:
Section FA: Monday 11:45 – 13:35 room MB S1.435
Section FB: Monday 11:45 – 13:35 room H-1001
Section FC: Wednesday 11:45 – 13:35 room H-562

Tutorial Instructors:
Section FA: Mohammadhossein Fakharan, email: mh.fakharan95@gmail.com
Section FB: Aref Afzali, email: afzaliaref.aa@gmail.com
Section FC: Mohammadhossein Fakharan, email: mh.fakharan95@gmail.com

Assignment marking:
Parsa Kamalipour, email: parsa.kamalipour@mail.concordia.ca

Labs: N/A

Course Calendar Description:
General principles of counting, permutations, combinations, identities, partitions, generating functions, Fibonacci numbers, Stirling numbers, Catalan numbers, principle of inclusion and exclusion. Graphs, subgraphs, isomorphism, Euler graphs, Hamilton paths and cycles, planar graphs, Kuratowski's theorem, trees, colouring, 5-colour theorem, matching, Hall's theorem.

Prerequisites: *COMP 232 or 18 credits in post-Cegep Mathematics*
Co-requisites: *N/A*

Specific Knowledge and Skills Needed for this Course:
Students taking this course are expected to have sufficient knowledge of the following topics. Should you have difficulties in any of these topics, you are strongly encouraged to review them before the DNE deadline.

Set theory. Elements of number theory. Functions, Relations. Propositional logic and predicate calculus. Mathematical proof techniques: direct proof, indirect proof, proof by contradiction, proof by induction.

Course materials
Required Textbook:
Discrete and Combinatorial Mathematics: An Applied Introduction (fifth edition) by Ralph P. Grimaldi, Addison-Wesley, 2003, ISBN 0-201-72634-3

Grading Scheme
Quiz - 0%
Assignments - 25%
Midterm Exam - 25% (October , in class)
Final Exam – 50%

Tentative Course Schedule

Week 1: The Rules of Sum and Product. Permutations, combinations; The Binomial Theorem (Sections 1.1-1.3).
Week 2: Combinations with Repetition. Mathematical Induction, Recursive Definitions (Sections 1.4, 4.1-4.2)
Week 3: The Principle of Inclusion and Exclusion, Generalization (Sections 8.1-8.2)
Week 4: Generating Functions (Sections 9.1 - 9.4)
Week 5: Recurrence Relations (Section 10.4)
Week 6: Midterm
An introduction to Graph Theory (Sections 11.1 - 11.2)
Week 7: Euler graphs, Planar graphs, Kuratovski's Theorem (Sections 11.3-11.4)
Week 8: Hamilton paths and cycles (Section 11.5)
Week 9: Graph colouring, 5-colour Theorem (Section 11.6)
Week 10: Trees (Sections 12.1-12.2)
Week 11: Rooted trees, Catalan numbers. m-ary trees (Section 12.2)
Week 12: Matching, Hall's Theorem (Section 13.4)
Review.

Lab Details
N/A

Engineering Tools
N/A

Graduate Attributes:
The following is the list of graduate attributes (skills) that students use, learn and/or apply throughout the term.

Use mathematical knowledge and proof techniques applied to problems related to design and analysis of algorithms.

Course Learning Outcomes (CLOs):

Upon completion of this course, the student will:

- Learn the methods of Inclusion and Exclusion and Generating Functions to solve difficult counting problems.
- Learn various topics in graph theory, including trees, bipartite graphs, Hamiltonian cycles, connectivity, planar graphs, Euler's formula, graph coloring, and matching theory.
- Improve their problem-solving skills by proving and applying theorems about graphs.
- Use graph-theoretic techniques to be applied for design and analysis of algorithms.

Health and Safety Guidelines

All health and safety rules specific to this course can be found in the lab manual. General health and safety instructions and available health and safety trainings can be found at:
Safety Programs - Concordia University (https://www.concordia.ca/campus-life/safety/general-safety.html)

If your course has additional information about health and safety guidelines/training, please insert them here.

On Campus Resources

Please visit Student services at Concordia University for the services available Gina Cody School students.