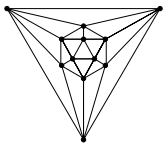

MATH 4343
Introduction to Graph Theory
2024-25 Spring

https://canvas.ust.hk/courses

Lecture

Time	Monday and Wednesday 10:30pm-11:50am
Venue	G009A, GYT
Instructor	**Prof. Beifang Chen**
E-mail	mabfchen@ust.hk
Office	Room 3458, Office Hour: Wed, 4:00pm-6:00pm

Tutorial

Time	Tuesday 6:00pm-6:50pm
Venue	Room 2465, Lift 25-26
Teaching Assistant	**Ying Cao**
E-mail	ycaobf@connect.ust.hk
Office	Room 3412, Office Hour: by appointment

Course Description

Course outline: This course is to equip students with basic knowledge of graph theory that will be needed in mathematics, computer science, and engineering (in particular network analysis). Topics include but not restricted to: Euler tours and Chinese postman problem, Hamilton cycles and traveling sales problem; minimum spanning trees and searching algorithms; block decomposition, ear decomposition, connectivity and edge connectivity; network flows, Ford-Fulkerson (Max-Flow Min-Cut) theorem, augmenting-path algorithm; planar graphs, Euler formula, duality, Kuratowski theorem; maximum matchings and perfect matchings, matchings in bipartite graphs, matchings in general graphs, Tutte-Berge theorem, Petersen theorem; probabilistic method, page rank problem, random walks; cycle spaces and bond spaces, Laplacian, matrix-tree theorem; Four-Color problem, colorings and flows, chromatic number and flow number, chromatic polynomial, flow polynomial, Tutte polynomial.

Credits: 4

Prerequisites: Discrete Structure (MATH 2343) and Linear Algebra (MATH 2121/2131).

Textbooks and References

References: The major reference is the instructor's lecture notes which will be posted on Canvas from time to time. In addition, the following reference books are recommended:

(1) J.A. Bondy and U.S.R. Murty, *Graph Theory*, Springer 2008 (Second Edition).
(2) J.A. Bondy and U.S.R. Murty, *Graph Theory with Applications*, North-Holland 1979.
(3) R. Diestel, *Graph Theory*, Springer 2000 (Electronic Edition).

Intended Learning Outcomes (ILOs)

Upon completion of this course, students are expected to:

(a) Develop concrete knowledge to understand the core concept and ideas of graph theory. Be able to formulate problems in the language of graph theory.
(b) Recognize the power of abstraction and generalization and carry out investigative mathematical work with independent judgment.
(c) Master the basic concepts and techniques of graph theory; apply the fundamental principles, formulas, algorithms, and other techniques to formulate problems in related areas and solve them in skills.
(d) Try unsolved problems and try to formulate new problems for research.

Assessment and Grading

Homework: There will be four sets of problems. Each contains six problems. Students should submit each homework in the form of a clearly written and scanned or a LaTeX-typed PDF on the Canvas system before the deadline. No late homework is accepted, unless agreed upon by the TA.

Examinations: There will be a one hour twenty minute midterm exam during Week 6-7 (the exact date to be confirmed) and a three hour final exam arranged by ARO.

Make-up midterm policy:

- Under any circumstance, students who are unable to attend the midterm exam will **not** be offered a makeup test that takes place after the regular exam session.
- For students who have valid reasons for missing the midterm (such as time crash with another midterm), the instructor may approve an early midterm, or assign the midterm marks according to the final exam performance.
- However, for students who miss the midterm without a valid reason, the midterm score will be considered 0. This includes self-claimed sickness without any medical statement.

Makeup final exam policy: For final exams, the course will follow the makeup exam policy set by ARO. The approval of the instructor, the dean, and ARO will be needed to apply for a final makeup exam, and students must complete the final makeup exam within 1 week after the approval decision from ARO. In any circumstance, the makeup final exam will use a different set of problems, and there is no guarantee that the level of difficulty remains the same as the regular sitting.

Grading Scheme:

	percentage	Address ILOs
Attendance/Homework	15%	1, 2, 3
Midterm	35%	1, 2, 3
Final	50%	1, 2, 3
Course Total	100%	100%

Tentative Course Schedule

- Week 1: Graphs and subgraphs (Ch.1,2)
- Week 2-3: Cycle spaces and tensions spaces
- Week 4: Connected graphs and trees, Non-separable graphs (Ch 3,4)
- Week 5: Non-separable graphs (Ch 5)
- Week 6: Tree searching algorithms (Ch 6)
- Week 7: Flow in networks (Ch 7) (Midterm exam: March 14, 6pm)
- Week 8: Connectivity (Ch 9)
- Week 9-10: Planar graphs, Four-Color Problem (Ch 10, 11)
- Week 11-12: Coloring and chromatic polynomial (Ch 15)
- Week 12-13: Probabilistic method (Final exam: arranged by ARR)