

MATH 4022 (Intro to Graph Theory) Fall 2016

- **Instructor:** Prasad Tetali, tetali-at-math-dot-gatech-dot-edu; 404-894-9238 (o)
- **Class Location and Time:** Skiles 268, MW 3:05–4:25pm
- **Office hours:** Skiles 118B, Monday 4:30-5:30, Tuesday, Friday 2:00–3:00pm
- **Prerequisites:** Combinatorics (Math 3012) or Consent of Instructor

Suggested Textbooks:

- (1) *Introduction to Graph Theory*, by Doug West (2nd edition, Prentice-Hall, 2001).
- (2) *Graph Theory with Applications*, by J.A. Bondy & U.S.R. Murty (North-Holland, 1976.): available for free download on the internet:
<http://www.iro.umontreal.ca/~hahn/IFT3545/GTWA.pdf>

Also hand-outs will be distributed when appropriate.

Course Objective.

- To develop appreciation of and interest in graph theory and its many applications

Syllabus: Based on material in Chapters 2 – 6 of the first textbook and some sections from Book 2. Familiarity with basic material in Chapter 1 will be assumed. Some sections will be omitted (e.g. Sec. 3.3), and time permitting, a couple of sections from other chapters (e.g. Secs. 7.1 and 8.1) in the book will be covered. The emphasis will be on the following fundamental Theorems and Algorithms.

Theorems and Topics:

- Sperner's Lemma (from Book 2)
- The Matrix-tree theorem
- Hall's matching condition and Tutte's theorem
- Connectivity and Menger's theorems
- Max-flow Min-cut theorem
- Vertex coloring, Brooks' theorem, Large girth and large chromatic number
- Edge coloring and Vizing's theorem (Proof: time permitting)
- Planarity and Kuratowski's theorem (No proof)
- Intro to Spectral graph theory: Eigenvalues, Hoffman's bound, Cheeger's inequality
- Intro to Extremal graph theory: Mendel, Turán, Ramsey theorems (Some proofs)

Applications:

- The Timetabling Problem (Book 2)
- The Optimal Assignment Problem (Book 2)
- Chinese Postman Problem
- Applications of Max-flow Min-cut Theorem
- Graph partitioning

Algorithms:

- Shortest paths and Minimum spanning tree algorithms (Brief review)
- Bipartite Matching (The Hungarian algorithm)
- Ford-Fulkerson algorithm
- Finding a "Cheeger cut"

General grading policy :

HWs 20% ; Two Quizzes 10% ; Two Tests 35% ; Final 35%

Quiz 1: Wednesday, September 14th (2nd half of the class period)

Test 1: Monday, October 3rd (full class period)

Quiz 2: Monday, October 24th (2nd half of the class period)

Test 2: Monday, November 7th (full class period)

FINAL EXAM: December 9th, 2:50-5:40pm

Homeworks will be assigned, collected and graded on a regular basis. You are strongly advised to (attempt to) solve all the homework problems.

Late submission of HWs is discouraged with a penalty of 20%.

Academic Dishonesty: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations of the Georgia Tech Honor Code will be submitted directly to the Dean of Students. The institute honor code is available at: <http://policylibrary.gatech.edu/student-affairs/academic-honor-code>

Suggestions:

- Please feel free to ask questions at any time: before, after or during the class.
- Please make use of my office hours.
- Class participation and discussion is highly encouraged.