**AMAT 587 - Graph Theory**
Class: MWF 12:35 PM - 01:30 PM in ES 153


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| **Instructor** | Elizabeth Munch, Ph.D. |
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| **Office Hours** | (TBD) |


**Course Description:**
Graphs, in particular networks consisting of vertices and edges, arise in many contexts including data analysis, mathematical modeling, computer science. In this class, we will cover the basic definitions and results in graph theory, including trees, spanning trees, connectivity, paths, directed graphs, planar graphs, etc. In addition, we will discuss some branches of graph theory including its involvement in algorithmic complexity and the famous "$\mathcal{P}$ vs $\mathcal{NP}$" problem, Ramsey theory, random graphs, and spectral graph theory.

**Prerequisites:**
This course requires a basic level of mathematical sophistication as a prerequisite. Knowledge of set theory, proof techniques, and some basic linear algebra (in particular: matrices, matrix multiplication, eigenvalues) will be assumed. Students who are not graduate level mathematics majors should get permission from the instructor.

**Website:**
The blackboard website, `http://blackboard.albany.edu`, has announcements about the course and any necessary files. Homework will also be announced and saved on this website.

**Textbook:**
Graph Theory - J.A. Bondy and U.S.R. Murty

**Grading:**

- **Homework:** The grade in this class will be entirely based on homeworks. There will be approximately bi-weekly homework sets given which will be turned in for a grade. This homework will be typeset in LaTeX or no credit will be given.
- **Points:** Your grade will be based on the total number of accumulated points from the semester. Late homeworks will be accepted until the end of class on the Monday following the due date with a 5 point penalty. The *estimated* number of points is below.

| | *Estimated Points* |
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| Homeworks | 7 homeworks $\times$ 50 points |
| TOTAL: | 350 |

**Approximate schedule - subject to modification:**

| Week | Date | Topic | Reading | Other |
|---|---|---|---|---|
| 1 | Aug 26 | Graphs | 1.1 | |
| | Aug 28 | Isomorphisms and Automorphisms | 1.2 | |
| 2 | Aug 31 | Special cases | 1.3-6 | |
| | Sep 2 | Subgraphs & Supergraphs | 2.1 | |
| | Sep 4 | Spanning, Induced graphs | 2.2-3 | |
| 3 | Sep 7 | NO CLASS | | |
| | Sep 9 | Decomposition and covering; cuts and bonds | 2.4-5 | |
| | Sep 11 | Walks, connected graphs | 3.1 | HW 1 Due |
| 4 | Sep 14 | NO CLASS | | |
| | Sep 16 | Edge cuts, Euler Tours | 3.2-3 | |
| | Sep 18 | Trees | 4.1 | |
| 5 | Sep 21 | Spanning trees | 4.2 | |
| | Sep 23 | NO CLASS | | |
| | Sep 25 | Cut vertices, separations and blocks | 5.1-2 | HW 2 Due |
| 6 | Sep 28 | Ear decompositions | 5.3-4 | |
| | Sep 30 | Tree search Algorithsm | 6.1 | |
| | Oct 2 | Min weight spanning tree, branching search | 6.2-3 | |
| 7 | Oct 5 | Flows; Max flow min cut | 7.1-2 | |
| | Oct 7 | Menger's theorem | 7.3 | |
| | Oct 9 | Algorithm Complexity | 8.1 | HW 3 Due |
| 8 | Oct 12 | Polynomial reductions, NP-complete problems | 8.2-3 | |
| | Oct 14 | Approximation, greedy methods, Linear Programming | 8.4-6 | |
| | Oct 16 | Vertex connectivity | 9.1 | |
| 9 | Oct 19 | Fan Lemma, Edge connectivity | 9.2-3 | |
| | Oct 21 | Planar graphs | 10.1 | |
| | Oct 23 | Duality | 10.2 | HW 4 Due |
| 10 | Oct 26 | Euler's Formula, Bridges | 10.3-4 | |
| | Oct 28 | Kuratowski's Theorem | 10.5 | |
| | Oct 30 | Suface embedding of graphs | 10.6 | |
| 11 | Nov 2 | Four color theorem | 11.1 | |
| | Nov 4 | Stable sets, Turan's Theorem | 12.1-2 | |
| | Nov 6 | Ramsey's Theorem | 12.3 | HW 5 Due |
| 12 | Nov 9 | Regularity Lemma | 12.3 | |
| | Nov 11 | Random Graphs | 13.1 | |
| | Nov 13 | Expectation and Variance | 13.2-3 | |
| 13 | Nov 16 | Evolution of Random Graphs | 13.4 | |
| | Nov 18 | Chromatic number | 14.1 | |
| | Nov 20 | Critical graphs, girth | 14.2-3 | Hw 6 Due |
| 14 | Nov 23 | Perfect Graph | 14.4 | |
| | Nov 25 | NO CLASS | | |
| | Nov 27 | NO CLASS | | |
| 15 | Nov 30 | Adjacency Polynomial and Chromatic Polynomial | 14.5-6 | |
| | Dec 2 | Matchings | 16.1-2 | |
| | Dec 4 | Perfect matchings, Algorithms | 16.4-5 | HW 7 Due |
| 16 | Dec 7 | Spectrum of a graph, Laplacian | | |
| | Dec 9 | Cheeger's Inequality | | |