Math 238A: Topics in Applied Mathematics, Fall 2025

Instructor: Yangyang Wang
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Office Hours: T, F, 2:10-3:10 pm, Goldsmith 302
Class Time / Location: T, F 12:45pm-2:05pm, Goldsmith: 117

Course Description

This course introduces mathematical frameworks used to analyze networks, with examples ranging from large-scale networks we encounter daily, such as transportation networks, the internet, and world wide web, to biological networks within our bodies, such as neural circuits, gene regulatory networks, and intracellular signaling networks.

Tentative Course topics: Graph Theory, Structural properties of real-world networks, Biological and Social Networks, Random networks, Network centrality, Dynamical Systems on Networks, Symmetry-based reduction techniques, and computer software tools for analyzing dynamics imposed on networks.

Course objectives: Students will develop a mathematical perspective on networks, using tools from graph theory and dynamical systems, along with experience with computational software for analyzing and interpreting network behavior.

Prerequisites

It is assumed that students are proficient in linear algebra, calculus and differential equations. Recommended prerequisites include MATH 15, 20, and 37, though these may be waived upon consultation with the instructor.

Recommended References and Resources:

A First Course in Network Science, by Filippo Menczer, Santo Fortunato and Clayton A. Davis

Networks: An Introduction, by Mark Newman

Dynamical Systems on Networks, by Mason Porter & James Gleeson

Mathematical foundation of neuroscience, by Bard Ermentrout & David Terman

Dynamics and Bifurcation in Networks: Theory and Applications of Coupled Differential Equations, by Marty Golubitsky & Ian Stewart

Course Requirements and Grading

- Participation in discussions
- Final project (format to be determined; may involve a presentation on a selected paper or a network problem relevant to the course)

Instructor's Note

Course policies, grading and topics may be adjusted as necessary. Any changes will be communicated promptly.

Important Policies and Resources

Academic Integrity

Every member of the University community is expected to maintain the highest standards of academic integrity. A student shall not submit work that is falsified or is not the result of the student's own effort. Infringement of academic integrity by a student subjects that student to serious penalties, which may include failure on the assignment, failure in the course, suspension from the University or other sanctions. Please consult Brandeis University Rights and Responsibilities for all policies and procedures related to academic integrity. Students may be required to submit work via TurnItIn.com or similar software to verify originality. A student who is in doubt regarding standards of academic integrity as they apply to a specific course or assignment should consult the faculty member responsible for that course or assignment before submitting the work. Allegations of alleged academic dishonesty will be forwarded to the Department of Student Rights and Community Standards. Citation and research assistance can be found at Brandeis Library Guides - Citing Sources.

Breaks

Class meetings of 90 minutes include a 10-minute break, while class meetings of 180 minutes include two breaks, at the instructor's discretion.

Classroom Health and Safety

- Register for the Brandeis Emergency Notification System. Students who receive an emergency notification while attending class should notify their instructor immediately. In the case of a life-threatening emergency, call 911. As a precaution, review this active shooter information sheet.
- Brandeis provides this shuttle service for traveling across campus or to downtown Waltham, Cambridge and Boston.
- On the Brandeis campus, all students, faculty, staff and guests are required to observe the university's policies on physical distancing and mask-

wearing to support the health and safety of all classroom participants. Review up to date COVID-related health and safety policies regularly.

Course Materials/Books/Apps/Equipment

If you are having difficulty purchasing course materials, please make an appointment with your Student Financial Services or Academic Services advisor to discuss possible funding options, including vouchers for purchases made at the Brandeis Bookstore.

Library

The Brandeis Library collections and staff offer resources and services to support Brandeis students, faculty and staff. Librarians and Specialists from Research & Instructional Services, Public Services, Archives & Special Collections, Sound & Image Media Studios, MakerLab, AutomationLab, and Digital Scholarship Lab are available to help you through consultations and workshops.

Privacy

To protect your privacy in any case where this course involves online student work outside of Brandeis password-protected spaces, you may choose to use a pseudonym/alias. You must share the pseudonym/ alias with me and any teaching assistants as needed. Alternatively, with prior consultation, you may submit such work directly to me.

Student Support

Brandeis University is committed to supporting all our students so they can thrive. If a student, faculty, or staff member wants to learn more about support resources, the Support at Brandeis webpage offers a comprehensive list that includes these staff colleagues you can consult, along with other support resources:

- The Care Team
- Academic Services (undergraduate)
- Graduate Student Affairs
- Directors of Graduate Studies in each department, School of Arts & Sciences
- Program Administrators for the Heller School and International Business School
- University Ombuds
- Office of Equal Opportunity.