MATH 867: Topics in Applied Mathematics: Mathematics of Networks

Instructor	Artem Novozhilov
Office	Minard 408E22
E-mail	artem.novozhilov@ndsu.edu
Web	https://www.ndsu.edu/pubweb/~novozhil/Teaching/mathematics_of_networks.html
Online eval	https://www.ndsu.edu/pubweb/~novozhil/Teaching/evaluation_form.htm
Phone	(701) 231-8680
Lecture hours	MTWTF 1:15pm–3:30pm (NDSU Morrill Hall, Room 101)
Office hours	By appointment.
Textbook	Lecture notes will be provided.
Prerequisites	MATH 651 or MATH 680.
Course Description	Topics will vary and may include: Optimal Control, Robust control, Stability Analysis, Mathematics of Networks, Models in Biology, Levy processes, Asymptotic expansions. May be repeated for credit with change in subtopic.
Course Objectives	Networks are the language that is used today in numerous interdisciplinary studies that unite mathematicians, physicists, biologists, engineers, computer scientists, economists, etc. The major emphasis in the course will be put on the mathematical aspects of the complex network analysis. In particular, the course will tentatively include • Analysis of the random graphs of Erdős and Rényi: What a tractable mathematical null model of a network is, what its properties and peculiarities, including the threshold phenomena (such as appearance of the giant component). • Statistical properties of real-world graphs: Degree distributions, diameter, clustering and other statistics of networks. • More realistic random graph models: How to build a random graph with a given degree distribution. Analysis of the configuration model. • Scale-free distributions and power laws: Mathematical models to generate power law distributions. • Mathematical models of network formation: Preferential attachment model and its modifications; the small-world network. • Processes on random networks, including percolation and epidemics.
Class Attendance	Class attendance is expected. The students are solely responsible for missed handouts or announcements made during the lectures.

Homework The lecture notes will contain a number a problems that should be solved. There will be no graded homework.

Exams There will be one final take home exam.

Schedule

Week 1: Introduction. Networks in natural and social sciences. Graph theory and probability theory preliminaries.

Week 2: Erdős–Rényi random graphs. Phase transitions.

Week 3: Other models of random graphs. Configuration model. Generalized random graph.

Week 4: Processes on random graphs. Epidemics.

Grading The grading will be based solely on the final take home exam. The student will get A/B/C/D/F with the thresholds 80/50/30/20.

Academic Responsibility and Conduct The academic community is operated on the basis of honesty, integrity, and fair play. NDSU Policy 335: Code of Academic Responsibility and Conduct applies to cases in which cheating, plagiarism, or other academic misconduct have occurred in an instructional context. Students found guilty of academic misconduct are subject to penalties, up to and possibly including suspension and/or expulsion. Student academic misconduct records are maintained by the Office of Registration and Records. Informational resources about academic honesty for students and instructional staff members can be found at `www.ndsu.edu/academichonesty`.

Any student found guilty of academic dishonesty will receive a grade of 0 for the homework assignment, or quiz, or exam in question. In addition, every such student will be reported to the Chair of Mathematics, the Dean of their major college, the Dean of the College of Science and Mathematics, the Provost, and the Registrar. The Registrar will add any such student to NDSU's Student Academic Misconduct Database. (Multiple entries in this database may result in additional sanctions from NDSU.)

Special Needs Any students with disabilities or other special needs, who need special accommodations in this course are invited to share these concerns or requests with the instructor and contact the Disability Services Office as soon as possible.