MATH 451H: Methods of Applied Mathematics II (Capstone II)
Spring 2022 Course Syllabus

NJIT Academic Integrity Code: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

COURSE INFORMATION

Course Description: Small teams of students conduct research projects under the guidance of faculty members who perform applied research. Effective From: Spring 2009.

Number of Credits: 3

Prerequisites: Math 450H with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 451-H04	Professor L. Kondic

Office Hours for All Math Instructors: Spring 2023 Office Hours and Emails

Course Materials:

Basic Literature (will be provided by the instructor);
- 1. D. P. Landau, K. Binder: A Guide to Monte-Carlo simulations in Statistical Physics, 3rd edition, 2009
- 2. D. J. Acheson, Elementary Fluid Dynamics, 2005
- 3. M. P. Allen, D. J. Tildesley: Computer Simulations of Liquids, Oxford University Press, 1991
- 4. T. Kaczinski, K. Mischaikow, M. Mrozek, Computational Homology, Springer, 2004
- Additional research papers will be provided by the instructor

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 3, 2023**. It will be strictly enforced.

POLICIES

DMS Course Policies: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

Grading Policy: The final grade in this course will be determined as follows:

Projects and Presentations	70%
Final Report and Presentation	30%

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Cellular Phones: All cellular phones and other electronic devices must be switched off during all class times.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2023 Hours)

Further Assistance: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

Accommodation of Disabilities: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services office authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

https://www.njit.edu/accessibility/

Important Dates (See: Spring 2023 Academic Calendar, Registrar)

Date	Day	Event
January 17, 2023	Tuesday	First Day of Classes
January 23, 2023	Monday	Last Day to Add/Drop Classes
March 13, 2023	Monday	Spring Recess Begins
March 18, 2023	Saturday	Spring Recess Ends
April 3, 2023	Monday	Last Day to Withdraw
April 7, 2023	Friday	Good Friday - No Classes
May 2, 2023	Tuesday	Friday Classes Meet
May 2, 2023	Tuesday	Last Day of Classes
May 3 - May 4, 2023	Wednesday and Thursday	Reading Days

May 5 - May 11, 2023	Friday to Thursday	Final Exam Period

Course Outline

Project 1: Stochastic modeling of frost spreading on microstructured surfaces

- Interact with experimental researchers to understand the state-of-the-art and relevance of frost spreading in applications
- Review the literature to understand the basic mechanisms involved in frost spreading: heat diffusion, phase change, mass transfer
- Develop appropriate continuum models for frost spreading on microstructured surfaces
- Based on continuum models, develop discrete Monte-Carlo type of simulations for frost spreading
- Compare the results of Monte-Carlo simulations to the experimental ones with focus on determining conditions leading to fractal nature of the spreading frost

Project 2: Graph theory-based quantification of membranes

- Understand the basics of modeling flow of fluid suspensions through membranes based on slender pores
- Implement the established algorithms to develop stochastic networks representing physical membranes
- Apply the methods emerging from computational topology to analyze topological properties of the established networks
- Develop quantitative measures describing developed stochastic networks and correlate these measures with the membrane absorption properties
- Interact with experimental scientists working on applications of membranes and porous media flow

Project 3: Computational topology applied to materials systems

- Interact with computational and experimental scientists working on experiments and simulations of materials systems involving large number of interacting particles
- Use the experimental and simulation data to develop network-based representation of interactions between the constitutive particles
- Developed computational topology-based description of the formulated networks
- Understand correlations between material and network properties
- Produce suggestions for future experiments to test the developed correlations