MATH 451: Methods of Applied Mathematics II (Capstone II)
Spring 2023 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-H02	Professor C. Diekman

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

Required Textbook: None. Textbook chapters and journal papers will be provided on Canvas.

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:

Attendance and In-Class Participation	10%
Projects and Presentations	60%
Final Report and Presentation	30%

Your final letter grade will be based on the following tentative curve.

A	90-100	**C**	60-69
B+	85-89	**D**	50-59
B	75-84	**F**	0-49
C+	70-74		

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.

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: Dynamical modeling of pyramidal neuron excitability using deep learning

- Interact with experimental researchers to learn about electrophysiological recording techniques, ion channels, and the role of pyramidal neurons in brain function
- Review the literature to understand the conductance-based ODE modeling framework for neuronal excitability
- Analyze voltage-clamp data to construct initial models of pyramidal neuron excitability
- Build a MATLAB GUI for fitting ion channel parameters to voltage-clamp data
- Review the literature on deep learning methods for solving stochastic inverse problems
- Analyze current-clamp data and extract key electrophysiological features
- Use these features and deep learning to refine the initial ODE models of pyramidal neuron excitability

Project 2: Dynamical modeling of cardiac excitability using deep learning

- Interact with experimental researchers to learn about electrophysiological recording techniques, ion channels, and sudden cardiac arrhythmias
- Review the literature to understand the conductance-based ODE modeling framework for single-cell cardiac excitability and PDE models of cardiac tissue
- Implement published ODE and PDE models of ventricular cardiomyocytes
- Analyze ECG data to extract key features of cardiac excitability across the circadian (24-hour) cycle
- Use these features and deep learning to infer the parameters of cardiac models at different phases of the circadian cycle
- Interpret the models to gain insight into why sudden cardiac death is more likely to occur at certain points of the day/night cycle

Project 3: Mathematical modeling and simulation of the trajectory of a bullet

- Details TBA