MATH 450H: Methods of Applied Mathematics I (Capstone I)
Fall 2025 Course Syllabus

NJIT Academic Integrity Code: Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at: NJIT Academic Integrity Code.

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu

COURSE INFORMATION

Course Description: This course presents an introduction to methods of applied mathematics for modeling problems in the life sciences and engineering. An introduction to analytical and computational methods will be presented and problems from biological systems, control and optimization, heat transfer and fluid flows, and data science will be considered. Applied mathematics techniques for the problem simplification will be introduced along with computational methods for the solution of full problems.

Number of Credits: 3

Prerequisites: MATH 331 with a grade of C or better, MATH 337 with a grade of C or better, and MATH 340 with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 450-H01	Professor S. Afkhami

Office Hours for All Math Instructors: Fall 2025 Office Hours and Emails

Required Textbook:

There is no mandatory text for this section. The following books and materials are recommended texts. I will teach mainly from my own notes; slides and lecture notes will be uploaded on Canvas.

- Introduction to the Foundations of Applied Mathematics; Mark H. Holmes; 978-0-387-87749-5
- Mathematical Models in the Applied Sciences; A. C. Fowler, University of Oxford; 9780521467032

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, November 10, 2025**. 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:

Homework	50%
Midterm Exam	20%
Final Exam	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.

Religious Observance: NJIT is committed to supporting students observing religious holidays. Students must notify their instructors in writing of any conflicts between course requirements and religious observances, ideally by the end of the second week of classes and no later than two weeks before the anticipated absence.

Exams: There will be one exam during the semester and a cumulative final exam during the final exam week:

Midterm Exam	TBA
Final Exam Period	December 14 - December 20, 2025

Makeup Exam Policy: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

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

Generative AI: Student use of artificial intelligence (AI) tools is permitted in this course but you must indicate where and how you have used these tools. Additionally, if and when students use AI in this course, the AI must be cited as is shown within the NJIT Library AI citation page for AI. If you have any questions or concerns about AI technology use in this class, please reach out to your instructor prior to submitting any assignments. Note that students are ultimately responsible for developing skills in the course content area and therefore assignments that have errors and incorrect results will be graded accordingly regardless of whether or not AI tools are used. If you use AI in your coursework, you are encouraged to attempt to understand generated materials.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Fall 2025 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 need an accommodation due to a disability, please contact the Office of Accessibility Resources and Services at oars@njit.edu, or visit Kupfrian Hall 201 to discuss your specific needs. A Letter of Accommodation Eligibility from the office authorizing student accommodations is 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: Fall 2025 Academic Calendar, Registrar)

Date	Day	Event
September 1, 2025	Monday	Labor Day
September 2, 2025	Tuesday	First Day of Classes
September 8, 2025	Monday	Last Day to Add/Drop Classes
November 10, 2025	Monday	Last Day to Withdraw
November 25, 2025	Tuesday	Thursday Classes Meet
November 26, 2025	Wednesday	Friday Classes Meet
November 27 to November 30, 2025	Thursday to Sunday	Thanksgiving Recess - Closed
December 11, 2025	Thursday	Last Day of Classes
December 12, 2025	Friday	Reading Day 1
December 13, 2025	Saturday	Saturday Classes Meet
December 14 to December 20, 2025	Sunday to Saturday	Final Exam Period

Course Outline

Introduction to Mathematical Modeling

The procedure of modeling
Derivation of the mathematical model from first principles
Examples
Dimensional Analysis and Scaling
Nondimensionalization and dimensionless parameters
Buckingham theorem
Scaling and size arguments
Perturbation Methods and Asymptotic Analysis
Regular and singular perturbation
Boundary layer theory
Optimization
Linear and nonlinear optimization
Lagrange multipliers
Data-Driven Models
Function fitting
Least squares
Singular value decomposition
Applications of data analysis
Mathematical Models of Continua

Mathematical models of continua
Fluids flow
Elasticity
Stochastic Models
Stochastic processes
Stochastic differential equations