

Fall 2023

MATH 450H-H01, Fall 2023: Methods of Applied Mathematics I (Capstone I)

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MATH 450H: Methods of Applied Mathematics I (Capstone I)

Fall 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: 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 2023 Office Hours and Emails](#)

Required Textbook:

There is no mandatory text for this section. The following books and materials are recommended texts.

- Mathematical Models in the Applied Sciences; A. C. Fowler, University of Oxford; 9780521467032
- Introduction to the Foundations of Applied Mathematics; Mark H. Holmes; 978-0-387-87749-5
- An Introduction to Mathematical Modeling (Dover Books on Computer Science); Edward A. Bender; 978-0486411804

University-wide Withdrawal Date: The last day to withdraw with a W is **Monday, November 13, 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:

| | |
|--------------|-----|
| 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.

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 17 - December 23, 2023 |

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.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: [Fall 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 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:

Important Dates (See: [Fall 2023 Academic Calendar](#), Registrar)

| Date | Day | Event |
|----------------------------------|-----------------------|------------------------------|
| September 4, 2023 | Monday | Labor Day |
| September 5, 2023 | Tuesday | First Day of Classes |
| September 11, 2023 | Monday | Last Day to Add/Drop Classes |
| November 13, 2023 | Monday | Last Day to Withdraw |
| November 21, 2023 | Tuesday | Thursday Classes Meet |
| November 22, 2023 | Wednesday | Friday Classes Meet |
| November 23 to November 26, 2023 | Thursday and Saturday | Thanksgiving Recess - Closed |
| December 13, 2023 | Wednesday | Last Day of Classes |
| December 14, 2023 | Thursday | Reading Day 1 |
| December 15, 2023 | Friday | Reading Day 2 |
| December 17 to December 23, 2023 | Sunday to Saturday | Final Exam Period |

Course Outline

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| 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 |

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| 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 |

*Updated by Professor S. Afkhami - 8/10/2023
Department of Mathematical Sciences Course Syllabus, Fall 2023*