# MATH 613: Advanced Applied Mathematics I: Modeling
## *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.

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**: Concepts and strategies of mathematical modeling are developed by investigation of case studies in a selection of areas. Consistency of a model, nondimensionalization and scaling, regular and singular effects are discussed. Possible topics include continuum mechanics (heat and mass transfer, fluid dynamics, elasticity), waves, kinetics, population dynamics, traffic flow, and the Sommerfeld problem.

**Number of Credits**: 3

**Prerequisites**: MATH 331 and MATH 337, or departmental approval.

**Course-Section and Instructors:**

| Course-Section | Instructor |
|---|---|
| Math 613-001 | Professor J. Jaquette |

**Office Hours for All Math Instructors:** Fall 2023 Office Hours and Emails

**Required Textbook:**

| | |
|---|---|
| **Title** | *Introduction to the Foundations of Applied Mathematics* |
| **Author** | Mark Holmes |
| **Edition** | 2nd |
| **Publisher** | Springer |

| | |
|---|---|
| **ISBN #** | 9783030242602<br>9783030242619 |

**University-wide Withdrawal Date**: The last day to withdraw with a **W** is **Monday, November 13, 2023**. It will be strictly enforced.

## COURSE CONTENT & OBJECTIVES

Concepts and strategies of mathematical modeling are developed by investigation of case studies in a selection of areas. Consistency of a model, nondimensionalization and scaling, regular and singular effects are discussed. Possible topics include continuum mechanics (heat and mass transfer, fluid dynamics, elasticity), vibrating strings, population dynamics, traffic flow, and the Sommerfeld problem.

By the end of the course, students will be able to:

- Solve quantitative problems in applied math.
- Critically read graduate textbooks, summarize the major points, and discuss the finer details.
- prepare and deliver 15 minute presentations on applied mathematics and modeling.

## 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:

| | |
|---|---|
| **Presentations (8) and Participation (2)** | 10% |
| **Homework** | 25% |
| **Midterm Exam** | 30% |
| **Final Exam** | 35% |

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

| | | | |
|---|---|---|---|
| **A** | 84 - 100 | **C+** | 60 - 69 |
| **B+** | 77 - 83 | **D** | 50 - 59 |
| **B** | 70 - 76 | **F** | 0 - 49 |

**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.

**Working in Groups:** I **highly recommend** finding a friend or two in this class and studying together! It makes doing homework more enjoyable (or less miserable?), and helps you learn difficult material. Even if you think you know everything, explaining concepts to someone else will help you master the material.
That said, the homework you turn in must be your own. Don't just copy someone else's work -- be it someone else in the class or someone online. If you get a significant idea or assistance from a classmate or an outside

source, **BE SURE** to reference them. Citing your sources is one of the best way to avoid representing other's work as your own. While group work is great for preparing presentations and doing homework, the work you do on the midterm/final exams should be all your own.

**Seminar Format:** This course is a seminar and, unlike a traditional course, almost all of the talking in our meetings is done by the students. The main work of the seminar meeting will be presentations on selected topics, discussion of the readings and presentations, discussion of student generated questions, and presentation and discussion of homework problems. I'd like the seminar atmosphere to be lively but not intimidating. The goal of the group should be to push everyone's understanding. If something isn't clear, we need to stop and clarify.

In this format, the seminar members will be expected to have mastered all the basic background material before seminar, and the seminar meeting will be devoted to reinforcing, extending and enhancing your knowledge of the seminar topics. Students presenting material in any given week must thoroughly prepare those presentations in advance. Students not presenting material should still study all of the material to be presented in advance so that they may ask good questions and participate fully in the discussions. If you are unable to attend class for any reason, please contact me as soon as possible.

**Meeting Organization:** Below is an example agenda for one week's seminar:

Monday Class:
- Brief summary of the week's reading (5 min)
- Student presentations (40-60 min)
- Discussion of students' prepared questions on the reading (15-30 min)

Thursday Class:
- Plan which problems to discuss (5 min)
- Discussion of homework problems (65 min)
- Closing, and planning for the next week (5-10 min)

**Reading Questions:** Each week there will be about 25 pages from the book that everyone should read by Monday.

By Monday morning (before noon!), each student must email me a list of at least 3 questions they had from the reading. My suggestion would be to compile your list of questions as you are reading the week's material.

In class on Monday we will go around the room. Each person will pose one of their questions and the group will discuss. If there is time remaining we will discuss any further questions/topics the group finds to be of interest.

**Presentations:** Many seminars will include short presentations prepared by students. I'll ask for volunteers for presentations the week before. Presentations may include discussing a section from our text or another book, readings from journals, or examples relating to the week's reading.

Each presentation should be 10-15 minutes and leave 5 minutes for questions. You should not go overtime; I will set a timer. Each student is expected to present at least once before the midterm, and once after the midterm. In weeks that you are giving a presentation, you are REQUIRED to talk to me in office hours before hand to discuss your talk outline/ask questions about the material/etc.

**Homework Problems:** Each week there will be homework problems to accompany the reading. You are strongly encouraged to work together on problems.

At the beginning of each Thursday seminar we'll decide who will lead the discussion on which homework problems. You'll let me know the problems you feel most comfortable with and I'll respect your preferences.

Difficult problems we can all work on together.

A writeup of the week's homework problems will be due Friday morning, late work will be penalized. Time management is key! Your write up should be mostly be complete by class on Thursday.

**Exams**: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

| | |
|---|---|
| Midterm Exam | October 26, 2023 |
| Final Exam Period | December 17 - December 23, 2023 |

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

**Makeup Exam Policy**: To properly report your absence from a midterm or final exam, please review and follow the required steps under the DMS Examination Policy found here:

http://math.njit.edu/students/policies_exam.php

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

## ADDITIONAL RESOURCES

**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 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

***(This is a tentative schedule of material)***

| Week | Mon | Thurs | Topic | Reading |
|---|---|---|---|---|
| 1 | --- | 9/7 | Introduction & Dimensional Analysis | Ch 1 |
| 2 | 9/11 | 9/14 | Dimensional Analysis | Ch 1 |
| 3 | 9/18 | 9/21 | Perturbation Methods | Ch 2 |
| 4 | 9/25 | 9/28 | Kinetics | Ch 3 |
| 5 | 10/2 | 10/5 | Kinetics | Ch 3 |
| 6 | 10/9 | 10/12 | Diffusion | Ch 4 |
| 7 | 10/16 | 10/19 | Diffusion | Ch 4 |
| 8 | 10/23 | 10/26 | Diffusion / Midterm | Ch 4 |
| 9 | 10/30 | 11/2 | Traffic Flow | Ch 5 |
| 10 | 11/6 | 11/9 | Traffic Flow | Ch 5 |
| 11 | 11/13 | 11/16 | Continuum Mechanics, 1d | Ch 6 |
| 12 | 11/20 | *11/21* | Elastic Materials | Ch 7 |
| 13 | 11/27 | 11/30 | Continuum Mechanics, 3d | Ch 8 |
| 14 | 12/4 | 12/7 | Fluids | Ch 9 |
| 15 | 12/11 | --- | Review | --- |

*Updated by Professor J. Jaquette - 9/6/2023*
*Department of Mathematical Sciences Course Syllabus, Fall 2023*