MATH 440: Advanced Applied Numerical Methods
Spring 2025 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: A survey of numerical methods for solving ordinary and partial differential equations. Includes initial-value and boundary-value problems for ordinary differential equations and for elliptic, hyperbolic, and parabolic partial differential equations.

Course Objectives: The aim of the course is to teach computational methods for solving ordinary and partial differential equations. This includes the construction, application and analysis of basic computational algorithms. Problem solving by computers is a central part of the course.

Knowledge and understanding: A successful student should be able to discretize ordinary and partial differential equations and to independently implement and to apply such algorithms.

Skills and abilities: A successful student should

- be able to independently select and apply computational algorithms.
- be able to evaluate both accuracy and relevance of numerical results.
- report solutions to problems and numerical results in written form
    - on the construction of basic mathematical models and algorithms.
    - on the numerical solution of a mathematical problem.

Number of Credits: 3

Prerequisites: MATH 331 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 440	Professor R. Goodman

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

Required Textbook:

Title	*Introduction to Computation and Modeling for Differential Equations*
Author	Lennart Edsberg
Edition	2nd
Publisher	Wiley
ISBN #	ISBN-13: 9781119018445 DIGITAL ISBN-13: 9781119018452

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 7, 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:

Exercises	20%
Computational Labs	30%
Midterm I	12%
Midterm II	12%
Final Exam	26%

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

A	90 - 100	**C**	60 - 64
B+	85 - 89	**D**	50 - 59
B	75 - 84	**F**	0 - 49
C+	65 - 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.

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	May 10 - May 16, 2025

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: 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. Have you ever seen this video? It's a good one.

Artificial Intelligence: Students must work without artificial intelligence (AI) assistance to better develop their skills in this content area. As such, AI usage is not permitted throughout this course under any circumstance.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 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 are in need of accommodations due to a disability please If you need an accommodation due to a disability please contact the Office of Accessibility Resources and Services at oars@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 2025 Academic Calendar, Registrar)

Date	Day	Event
January 21, 2025	Tuesday	First Day of Classes

January 27, 2025	Monday	Last Day to Add/Drop Classes
March 16, 2025	Sunday	Spring Recess Begins
March 22, 2025	Saturday	Spring Recess Ends
April 3, 2025	Thursday	Wellness day
April 7, 2025	Monday	Last Day to Withdraw
April 18, 2025	Friday	Good Friday - No Classes
April 20, 2025	Sunday	Easter Sunday - No Classes Scheduled
May 6, 2025	Tuesday	Thursday Classes Meet
May 7, 2025	Wednesday	Friday Classes Meet
May 7, 2025	Wednesday	Last Day of Classes
May 8, 2025	Thursday	Reading Day 1
May 9, 2025	Friday	Reading Day 2
May 10 - May 16, 2025	Friday to Thursday	Final Exam Period

Course Outline

Week	Sections	Topic
Jan 20	*Bits of ch. 1-2, Appendix A.1* *9.4*	*Brief Intro to Numerical Methods, ODE Review, Newton's method for systems*
Jan 27	*3.1-3.3.3, Matlab handout*	*Explicit Euler Method for IVPs* *Matlab review and lab requirements*
Feb 3	*3.3.4-3.5*	*Stiff systems, Implicit Euler method and higher order methods*
Feb 10	*4.1-4.2.4*	*Finite difference methods for Boundary Value Problems*
Feb 17	*Supplement, 4.2.5-4.3*	*Numerical Methods for tridiagonal and sparse linear systems, nonlinear BVP, shooting, "Ansatz methods"*
Feb 24	*Ch 5*	*Tuesday: PDE background* *Thursday: Exam I (Initial and Boundary-Value*

		Problems, Linear Algebra)
Mar 3	*6.1-6.3*	*Parabolic PDE via the method of lines*
Mar 10	*6.4-6.5*	*Nonlinear parabolic PDE and ansatz methods*
Spring Break. Have fun. Don't do anything crazy. Maybe study a little.		
Mar 24	*7.1-7.3*	*Finite Difference Method for Elliptic PDE* *Friday off for Good Friday*
Mar 31 (no class Apr 3)	*7.4*	*Finite Elements for Elliptic PDE*
Apr 7	*Supplementary materials*	*Tuesday: Parabolic and elliptic PDE advanced topics* *Thursday: Exam II (Parabolic and Elliptic Equations)*
Apr 14	*Supplementary materials*	*Parabolic and Elliptic PDE Advanced Topics*
Apr 21	*8.1-8.2*	*Finite difference methods for Hyperbolic Problems*
Apr 28	*8.3*	*Numerical Stability for Hyperbolic PDE*
May 5	*Supplementary materials*	*Advanced Topics for Hyperbolic PDE*