

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 713: Advanced Scientific Computing Spring 2025 Graduate 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 be sure you read and fully understand our DMS Online Exam Policy.

COURSE INFORMATION

Course Description: Numerical methods for the solution of initial - and boundary-value problems for partial differential equations, with emphasis on spectral methods.

Number of Credits: 3

Prerequisites: MATH 614, MATH 712 or departmental approval, and proficiency in a computer programming language, e.g., Matlab, Python, C, C++, Fortran.

Course-Section and Instructors:

Course-Section	Instructor
Math 715-002	Professor M. Siegel

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

Required Textbook:

Title	Spectral Methods in Matlab
Author	Lloyd N. Trefethen
Edition	-
Publisher	SIAM
ISBN #	ISBN-13: 978-0898714654

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:

Homework/Projects	50%
Midterm Exam	20%
Final Project	30%

Your final letter grade will be based on the following boundaries. Note: This grading scale is tentative and serves only as a guide.

A	90 - 100	с	60 - 69
В+	85 - 89	D	50 - 59
В	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. Class attendance and participation can contribute up to 5% of the grade at the instructor's discretion.

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.

Homework: No late homework will be accepted.

Exams: There will be two exams during the semester:

Midterm Exam (Take-Home)	March 14 - March 17, 2025
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 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.

Al Usage: The usage of artificial intelligence (AI) is permitted in this course with citation. 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.

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 are in need of accommodations due to a disability please contact the Office of Accessibility Resources and Services at oars@njit.edu. The office, located in Kupfrian Hall, Room 201, can provide you with a Letter of Accommodation Eligibility (where appropriate). If you are comfortable doing so, please also contact the instructor directly.

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

Weeks	Subject Topic
1	Fundamentals of Spectral Methods - The Method of Weighted Residuals, Galerkin & Collocation Approximation of a Given Function, Galerkin & Collocation Approximation of the Solution of a Differential Equation.
2	Differentiation Matrices - Unbounded Grids - The Semi-Discrete Fourier Transform
3	Periodic Grids - The DFT and FFT - Smoothness and Spectral Accuracy
4	Time-Stepping and Stability Regions for the Fourier Method - Filtering
5	Polynomial Interpolation and Clustered Grids - Chebyshev Differentiation Matrices
6	Chebyshev Series and the FFT
7	Initial Boundary Value Problems and the Chebyshev Method
8	Stability of Time Marching Schemes for Chebyshev Methods
9	Iterative Schemes and Preconditioning for Fourier and Chebyshev Methods
10	Stiff and Singular Problems
11	Applications to Nonlinear PDEs, e.g., Burger's Equation, Kuramoto-Shivashinski Equation, etc.
12	Nonlinear PDEs (continued)
13	Boundary Value Problems - Eigenvalues and Pseudospectra
14	Polar Coordinates - Integrals and Quadrature Formulas

FINAL EXAM WEEK: May 10 - May 16, 2025

Updated by Professor M. Siegel - 2025 Department of Mathematical Sciences Course Syllabus, Spring 2025