

MATH 713: Advanced Scientific Computing *Spring 2021 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.

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 713-002	Professor P.G. Petropoulos

Office Hours for All Math Instructors: [Spring 2021 Office Hours and Emails](#)

Required Textbooks:

Title	<i>Spectral Methods in Matlab</i>
Author	Lloyd N. Trefethen
Edition	---
Publisher	SIAM
ISBN #	978-0898714654

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 5, 2021**. 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 Exam	30%

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

A	90 - 100	C	60 - 69
B+	85 - 89	D	50 - 59
B	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**. This policy will be strictly enforced.

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 (Take-Home)	March 12 - March 14, 2021
Final Exam Period	May 7 - 13, 2021

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

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 Chantonette Lyles, Associate Director of Office of Accessibility Resources and Services at **973-596-5417** or via email at lyles@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and Services 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/studentssuccess/accessibility/>

Important Dates (See: **Spring 2021 Academic Calendar**, Registrar)

Date	Day	Event
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January 19, 2021	T	First Day of Classes
January 23, 2021	S	Saturday Classes Begin
January 25, 2021	M	Last Day to Add/Drop Classes
March 14 - March 21, 2021	Su - Su	Spring Recess - No Classes
April, 2, 2021	F	Good Friday - No Classes
April 5, 2021	M	Last Day to Withdraw
May 4, 2021	T	Friday Classes Meet
May 4, 2021	T	Last Day of Classes
May 5 & May 6, 2021	W & R	Reading Days
May 7 - May 13, 2021	F - R	Final Exam Period

Course Outline

Week	Textbook Chapter	Topic
1	Notes	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	1, 2 + Notes	Differentiation Matrices - Unbounded Grids - The Semi-Discrete Fourier Transform
3	3, 4 + Notes	Periodic Grids - The DFT and FFT - Smoothness and Spectral Accuracy
4	Notes	Time-Stepping and Stability Regions for the Fourier Method - Filtering
5	5, 6 + Notes	Polynomial Interpolation and Clustered Grids - Chebyshev Differentiation Matrices
6	8 + Notes	Chebyshev Series and the FFT
7	Notes	Initial Boundary Value Problems and the Chebyshev Method
8	10 + Notes	Stability of Time Marching Schemes for Chebyshev Methods
9	Notes	Iterative Schemes and Preconditioning for Fourier and Chebyshev Methods
10	Notes	Stiff and Singular Problems
11	Notes	Applications to Nonlinear PDEs, e.g., Burger's Equation, Kuramoto-Shivashinski Equation, etc., from Published Research Papers (which will be provided)
12	Notes	Applications to Reaction-Diffusion Problems from Published Research Papers (which will be provided)
13	7, 9	Boundary Value Problems - Eigenvalues and Pseudospectra
14	11, 12	Polar Coordinates - Integrals and Quadrature Formulas
15	13, 14	More About Boundary Conditions - Fourth-Order Problems
FINAL EXAM WEEK: MAY 7 - 13, 2021		

