

MATH 453: High-Performance Numerical Computing

Spring 2019 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 covers state-of-the-art numerical algorithms for solving large scale problems accurately and efficiently. Topics include iterative methods for linear systems and eigenvalue computations, introduction to parallel programs and parallel numerical algorithms, and spectral methods. An instructor selected advanced topic will be included in the course.

Number of Credits: 3

Prerequisites: **MATH 391** with a grade of C or better and **MATH 440** with a grade of C or better.

Course-Section and Instructors

Course-Section	Instructor
Math 453-002	Professor S. Afkhami

Office Hours for All Math Instructors: [Spring 2019 Office Hours and Emails](#)

References:

- *Using MPI: Portable Parallel Programming with the Message-Passing Interface* by W. Gropp, E. Lusk, and A. Skellum, MIT Press.
- *Numerical Analysis of Spectral Methods: Theory and Applications* by D. Gottlieb and S. Orszag, SIAM.
- *Numerical Linear Algebra* by L. N. Trefethen and D. Bau, SIAM.
- *Spectral Methods in Matlab* by L. N. Trefethen, SIAM.

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 8, 2019**. 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	25%
Final Exam	25%

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.

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: **Spring 2019 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**.

All students must familiarize themselves with and adhere to the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. The Department of Mathematical Sciences takes these policies very seriously and enforces them strictly.

Accommodation of Disabilities: Disability Support Services (DSS) 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 Disability Support Services at **973-596-5417** or via email at **lyles@njit.edu**. The office is located in Fenster Hall Room 260. A Letter of Accommodation Eligibility from the Disability Support 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 Disability Support Services (DSS) website at:

- <http://www5.njit.edu/studentssuccess/disability-support-services/>

Important Dates (See: **Spring 2019 Academic Calendar, Registrar**)

Date	Day	Event
January 22, 2019	T	First Day of Classes
February 1, 2019	F	Last Day to Add/Drop Classes
March 17 - 24, 2019	Su - Su	Spring Recess - No Classes, NJIT Open
April 8, 2019	M	Last Day to Withdraw
April 19, 2019	F	Good Friday - No Classes, NJIT Closed
May 7, 2019	T	Friday Classes Meet/ Last Day of Classes
May 8 & 9, 2019	W & R	Reading Days
May 10 - 16, 2019	F - R	Final Exam Period

Course Outline

Weekly Schedule (Approximate)

Week #	Topic
Week 1	Introduction to high-performance computing
Week 2	Introduction to parallel computing, speedup, efficiency, cost optimality
Week 3	Introduction to Open MP
Week 4	Parallel matrix and vector operations
Week 5	Sparse matrices
Week 6	Iterative methods, Jacobi, Gauss-Seidel
Week 7	Parallelizable methods for large linear systems, GMRES
Week 8	MIDTERM EXAM / Preconditioning techniques, multicoloring
Week 9	Conjugate Gradient
Week 10	Spectral methods I: Introduction to FFT
Week 11	Spectral methods II: Interpolation, integration and differentiation, boundary value problems.
Week 12	Spectral methods III: Boundary values problems for PDE, Chebychev methods
Week 13	Other applications of spectral methods
Week 14	Instructor selected advanced topic
Week 15	FINAL EXAM

*Updated by Professor S. Afkhami - 1/21/2019
Department of Mathematical Sciences Course Syllabus, Spring 2019*
