MATH 440: Advanced Applied Numerical Methods
Spring 2021 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.

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 L. Kondic

Office Hours for All Math Instructors: Spring 2021 Office Hours and Emails

Required Textbook:

Title	*Numerical Solution for Partial Differential Equations*
Author	K. W. Morton and D. F. Mayers
Edition	(1994)
Publisher	Cambridge
ISBN #	978-1139443203

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 5, 2021**. It will be strictly enforced.

COURSE NOTES

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.

Specifically

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

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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:

Homeworks and Projects	50%
Midterm Exam	20%
Final Exam	30%

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

A	90 - 100	C	65 - 74
B+	85 - 89	D	55 - 64
B	80 - 84	F	0 - 54
C+	75 - 79		

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	TBA
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: 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.

ADDITIONAL RESOURCES

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2021 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: 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 the 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 Accessibilty 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/studentsuccess/accessibility/

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

Date	Day	Event
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 Witdraw
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	Topic
1	Overview of computing software and general methods of scientific computing; Methods for solving large systems of linear equations;

2	Overview of linear ODE's; Finite Difference Methods;
3	Spectral methods for Linear ODE's; Elliptic problems; Derichlet and Neumann problems boundary conditions;
4	Boundary Integral Methods for Elliptic problems;
5	Nonlinear elliptic problems; Applications to problems in electrostatic and ideal fluid flow;
6	Diffusion equation in one space dimension;
7	Efficiency, stability, convergence, and consistency of different schemes used for diffusion problems; Error analysis;
8	Spectral methods for diffusion equation; Diffusion equation in higher dimensions: explicit and ADI type of schemes;
9	Introduction to linear hyperbolic equations; Method of characteristics;
10	Lax-Wendroff and leap-frog schemes; Inviscid Burgers equation;
11	Shocks solutions to Burgers equation; Systems of hyperbolic equations;
12	Conservation Laws;
13	Applications of hyperbolic equations to gas dynamics;
14	Student presentations; Review