

## MATH 440-002: Advanced Applied Numerical Methods *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:** 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 440-002	Professor D. Shirokoff

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

**Required Textbook:**

<b>Title</b>	<i>Intro to Computation and Modeling for Differential Equations</i>
<b>Author</b>	Lennart Edsberg
<b>Edition</b>	1st
<b>Publisher</b>	Wiley
<b>ISBN #</b>	978-0470270851
<b>Website</b>	<a href="#">Textbook Homepage</a>
<b>Supplementary</b>	<i>Elementary Numerical Analysis</i> , Atkinson & Han (M340 book) <i>Finite Difference Methods for Ordinary and Partial Differential Equations</i> , Randall LeVeque

**University-wide Withdrawal Date:** The last day to withdraw with a W is **Monday, April 8, 2019**. It will be strictly enforced.

## COURSE NOTES

**Note:** This webpage will not be updated. Assignments and solutions to be posted on class [Moodle](#) page.

**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
- on the construction of basic mathematical models and algorithms.
- on the numerical solution of a mathematical problem.

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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:

<b>Exercises</b>	20%
<b>Computational Labs</b>	40%
<b>Midterm Exam</b>	15%
<b>Final Exam</b>	25%

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

<b>A</b>	90 - 100	<b>C</b>	65 - 74
<b>B+</b>	85 - 89	<b>D</b>	55 - 64
<b>B</b>	80 - 84	<b>F</b>	0 - 54
<b>C+</b>	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.

**Homework Policy:** A small number of exercises will be assigned, due at the beginning of class. In addition, "Computational Labs" (partially from textbook appendix C) will be assigned. An average above 40% in each of the three areas (exercises, labs, exams) is required to receive a passing grade, regardless of your overall average.

**Contacting Me:** If a problem seems undoable or just plain wrong, then tell me or ask for my help. Do not bang your head against a wall for a long time!

**Cellular Phones:** This video explains my feelings. Also, if you try to hide your phone under the desk while you text, I can see you!

**Exams:** There will be two midterm exams held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	March 14, 2019
Final Exam Period	May 10 - 16, 2019

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.

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## 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](mailto: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/studentsuccess/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

Week	Dates	Sections	Topic
1	1/19	Bits of ch. 1-2, Appendix A.1, 9.4	Brief Intro to Numerical Methods, ODE Review, Newton's method for systems
2	1/23, 1/26	3.1-3.3.3, Matlab handout	Explicit Euler Method for IVPs Matlab review and lab requirements
3	1/30, 2/2	3.3.4-3.5	Stiff systems, Implicit Euler method and higher order methods
4	2/6, 2/9	4.1-4.2.4	Finite difference methods for Boundary Value Problems
5	2/13, 2/16	Supplement, 4.2.5-4.3	Numerical Methods for tridiagonal and sparse linear systems, nonlinear BVP's, shooting, "Ansatz methods"
6	2/20, 2/23	Ch 5	Wednesday: PDE background <b>FRIDAY: EXAM I</b> (Initial and Boundary-Value Problems, Linear Algebra)
7	2/27, 3/2	6.1-6.3	Parabolic PDE via the method of lines
8	3/6, 3/9	6.4-6.5	Nonlinear parabolic PDE and ansatz methods
	<b>3/13-3/17</b>	<b>SPRING BREAK. NO CLASS.</b>	
9	3/20-3/23	7.1-7.3	Finite Difference Method for Elliptic PDE
10	3/27, 3/30	7.4	Finite Elements for Elliptic PDE
11	4/3, 4/6	Supplementary materials	Wednesday: Parabolic and elliptic PDE advanced topics <b>FRIDAY: EXAM II</b> (Parabolic and Elliptic Equations)
12	4/10	Supplementary materials	Parabolic and Elliptic PDE Advanced Topics
			<b>FRIDAY OFF FOR GOOD FRIDAY</b>
13	4/17, 4/20	8.1-8.2	Finite difference methods for Hyperbolic Problems
14	4/24, 4/27	8.3	Numerical Stability for Hyperbolic PDE
15	5/1	Supplementary materials	Advanced Topics for Hyperbolic PDE