NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 440-002: Advanced Applied Numerical Methods
Spring 2020 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 2020 Office Hours and Emails

Required Textbook:

Title	*Intro to Computation and Modeling for Differential Equations*
Author	Lennart Edsberg
Edition	2nd
Publisher	Wiley
ISBN #	978-0470270851
Website	Textbook Homepage
Supplementary	*Elementary Numerical Analysis*, Atkinson & Han (M340 book) *Finite Difference Methods for Ordinary and Partial Differential Equations*, Randall LeVeque

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 6, 2020**. It will be strictly enforced.

COURSE NOTES

Note: This webpage will not be updated. Assignments and solutions to be posted on class Canvas 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.

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:

Exercises	20%
Computational Labs	40%
Midterm Exam	15%
Final Exam	25%

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.

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 one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days:

Midterm Exam	March 31, 2020
Final Exam Period	May 8 - 14, 2020

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 2020 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 Kupfrian Hall, Room 201. 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:

- https://www.njit.edu/studentsuccess/accessibility/

Important Dates (See: Spring 2020 Academic Calendar, Registrar)

Date	Day	Event
January 21, 2020	T	First Day of Classes
January 31, 2020	F	Last Day to Add/Drop Classes
March 15 - 22, 2020	Su-Su	Spring Recess: No Classes/ University Open
April 6, 2020	M	Last Day to Withdraw

April 10, 2020	F	Good Friday - University Closed
May 5, 2020	T	Friday Classes Meet - Last Day of Classes
May 6 & 7, 2020	W & R	Reading Days
May 8 - 14, 2020	F - R	Final Exam Period

Course Outline

Week	Sections	Topic
1	Bits of ch. 1-2, Appendix A.1, 9.4	Brief Intro to Numerical Methods, ODE Review, Newton's method for systems
2	3.1-3.3.3, Matlab handout	Explicit Euler Method for IVPs Matlab review and lab requirements
3	3.3.4-3.5	Stiff systems, Implicit Euler method and higher order methods
4	4.1-4.2.4	Finite difference methods for Boundary Value Problems
5	Supplement, 4.2.5-4.3	Numerical Methods for tridiagonal and sparse linear systems, nonlinear BVP's, shooting, "Ansatz methods"
6	Ch 5	PDE background
7	6.1-6.3	Parabolic PDE via the method of lines
8	6.4-6.5	Nonlinear parabolic PDE and ansatz methods
	Spring Break. No class.	
9	7.1-7.3	Finite Difference Method for Elliptic PDE
10	7.4	Finite Elements for Elliptic PDE
11	Supplementary materials	Wednesday: Parabolic and elliptic PDE advanced topics
		FRIDAY: EXAM (PARABOLIC AND ELLIPTIC EQUATIONS)
12	Supplementary materials	Parabolic and Elliptic PDE Advanced Topics
		Friday off for Good Friday
13	8.1-8.2	Finite difference methods for Hyperbolic Problems
14	8.3	Numerical Stability for Hyperbolic PDE
15	Supplementary materials	Advanced Topics for Hyperbolic PDE

Updated by Professor D. Shirokoff - 1/20/2020
Department of Mathematical Sciences Course Syllabus, Spring 2020