MATH 222: Differential Equations
Spring 2022 Course Syllabus

Advanced notice to students

To be ready for the class, please do the following right now:

1. Get the textbook. Make sure to purchase WileyPLUS access, as we will be using WileyPLUS for homework.
2. Download MATLAB (version 2021a or later) and install it on your laptop. Link below.
3. Install the Supplementary software (requires MATLAB 2021a or later, link below). Read or watch the instructions on the linked page. Make sure it works!

Prof. Goodman, the course coordinator, is happy to answer any questions about this, goodman@njit.edu

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.

DMS Online Exam Policy Spring 2022: In the event it is determined that DMS will conduct Common Exams online during Spring 2022, those exams will be administered in Canvas with proctoring using both Respondus LockDown Browser+Monitor on a computer (PC or Mac only; iPad and Chromebooks are not currently supported) and Webex on a phone or secondary device.

Please be sure you read and fully understand our DMS Online Exam Policy.

COURSE INFORMATION

Course Description: Methods for solving ordinary differential equations are studied together with physical applications, Laplace transforms, numerical solutions, and series solutions.

Number of Credits: 4

Prerequisites: Prerequisite: MATH 112 with a grade of C or better or MATH 133 with a grade of C or better.

Course-Section and Instructors:

Course-Section	Instructor
Math 222-002	Professor P. Rana Concepcion
Math 222-006	Professor P. Rana Concepcion
Math 222-008	Professor N. Tsipenyuk
Math 222-012	Professor M. Potocki-Dul
Math 222-014	Professor R. Goodman
Math 222-016	Professor M. Potocki-Dul
Math 222-018	Professor N. Tsipenyuk
Math 222-102	Professor J. Ratnaswamy
Math 222-104	Professor M. Potocki-Dul

Office Hours for All Math Instructors: Spring 2022 Office Hours and Emails

Required Textbook:

Title	*Elementary Differential Equations and Boundary Value Problems*
Author	Boyce and DiPrima
Edition	11th
Publisher	John Wiley & Sons, Inc.
ISBN #	WileyPLUS access only: 9781119499619 WileyPLUS access with print text: 9781119499688

Additional Information: Some review materials are on the course canvas page. Exam solutions, and MATLAB help are also posted there.

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 4, 2022**. It will be strictly enforced.

COURSE GOALS

Statement from coordinator: A traditional introductory course on differential equations focuses almost exclusively on methods for obtaining exact solutions to a few classes of simple differential equations for which such solutions exist. Most differential equations can not be solved using these techniques, and in this case methods involving computers are central to understanding how solutions behave. This semester, we will be enhancing the computational component of the class in order to better prepare students for the sort of work they are likely to do with differential equations in their future studies. The focus will not be simply on using the computer to solve

differential equations but on using computational methods to better understand how solutions behave.

Course Outcomes

Students should:

- Learn elementary analytical solution techniques for the solution of ordinary differential equations (ODEs).
- Interpret the solutions using plots and methods of calculus.
- Understand the solution structure of linear ODEs in terms of independent homogeneous solutions and nonhomogeneous solutions.
- Understand, by exposure to examples, how systems and phenomena from science and engineering can be modeled by ODEs, a principal example being the linear spring subject to forcing and damping
- Understand how the solution of such a model ODE can be used to analyze or predict a system's behavior.
- Understand the role of initial value problems for ODEs in examples from science & engineering.
- Learn how to use software to plot Slope Fields and Phase Planes for ODEs, and how to interpret the results.
- Understand an elementary method for the numerical solution of ODEs and have some familiarity with the solution of ODEs using MATLAB.
- Be introduced to two-point boundary value problems and Fourier series.

Course Outcomes

- Improved problem-solving skills, including knowledge of techniques for the solution of ODES.
- An understanding of the importance of differential equations in the sciences and engineering
- Preparation for further study in science, technology, engineering, and mathematics.

Course Assessment: The assessment of objectives is achieved through homework assignments on WileyPLUS and in MATLAB, weekly quizzes, and common examinations with common grading.

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:

WileyPlus Homework	10%
Quizzes	10%
MATLAB Assignments	16%
Common Midterm Exam I	17%
Common Midterm Exam II	17%
Final Exam	30%

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

A	88 - 100	**C**	58 - 63
B+	83 - 87	**D**	45 - 57

B	73 - 82	**F**	0 - 44
C+	64 - 72		

Attendance: 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. Quizzes and in-class MATLAB activities

Homework: Homework is to be completed using the online WileyPLUS platform which is accessed through the Math 222 Commons Canvas page. Problems corresponding to each week's lectures are due Monday night of the following week. There is a 25% penalty for late work. In the few sections with no WileyPLUS problems available, students are to do the work assigned for that section in the syllabus and upload the work to the Commons Canvas page.

Computing: The MATLAB-based computational component is integral to the class. All non-HCAD undergraduate students at NJIT are required to have a laptop. Basic information about MATLAB is here on Canvas. Information on downloading MATLAB is available on the NJIT Mathworks Portal.

- Students who fail to complete a significant portion of the class may be given a failing grade even if they are otherwise passing the course.
- All students should download
    a. MATLAB (and make sure it runs)
    b. The supplementary software for computing slope fields and phase planes
    c. MATLAB live scripts containing the three in-class activities (from the Canvas page for each activity).
- Alternatively, you may use MATLAB Online, a web-based version of MATLAB, available here. You will then need to save the supplementary software and in-class activities to MATLAB's cloud storage.
- There will be four in-class MATLAB activities. The weeks are indicated in the syllabus but the instructors will determine the exact days. On those days, students are required to bring their laptop to class with all required software installed. Any HCAD students without a laptop should make alternative arrangements with their instructor *at the beginning of the semester*.

WileyPLUS Regrading Policy: WileyPLUS homework is worth 10% of the class grade. That's about one letter grade. Therefore it is imperative that students do all of the assignments. On the other hand, there are well over 100 problems assigned over the course of the semester, making each individual problem worth less than 0.1% of the overall grade and very unlikely to affect any student's letter grade. Therefore, our policy is not to adjust scores on individual problems.

Exams: There will be three common midterm exams held during the semester and one comprehensive common final exam. Exams are held on the following days:

Midterm Exam I	Wednesday, February 23
Midterm Exam II	Wednesday, April 13
Final Exam Period	May 6 - May 12, 2022

The time of the midterm exams is 4:15—5:40 PM for daytime students and 5:45—7:10 PM for evening students. 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

Math Tutoring Center: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2022 Hours) The Math tutoring center has online tutoring in all 100 and 200 level math classes. You can drop in whenever it's open or make an appointment. There are special hours for MATLAB questions.

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.

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 Scott Janz, Associate Director of Disability Support Services at 973-596-5417 or via email at scott.p.janz@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibility Resources and 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 Office of Accessibility Resources and Services (OARS) website at:

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

Important Dates (See: Spring 2022 Academic Calendar, Registrar)

Date	Day	Event
January 18, 2022	Tuesday	First Day of Classes
January 22, 2022	Saturday	Saturday Classes Begin
January 24, 2022	Monday	Last Day to Add/Drop Classes
March 14, 2022	Monday	Spring Recess Begins
March 19, 2022	Saturday	Spring Recess Ends
April 4, 2022	Monday	Last Day to Withdraw
April 15, 2022	Friday	Good Friday - No Classes
April 17, 2022	Sunday	Easter Sunday - No Classes
May 3, 2022	Tuesday	Friday Classes Meet
May 3, 2022	Tuesday	Last Day of Classes
May 4 - May 5, 2022	Wednesday and Thursday	Reading Days
May 6 - May 12, 2022	Friday to Thursday	Final Exam Period

COURSE OUTLINE

Online homework is on Canvas. The sections covered in a given week are due by Monday night the following week.

Week + Dates	Section # + Topic		MATLAB Activities
WEEK 1: 1/18—1/21	1.1	Some Basic Models; Direction Fields	Project 1: MATLAB Onramp due 1/28
	1.2	Solutions of Some Differential Equations	
	1.3	Classification of Differential Equations	
WEEK 2: 1/24—1/28	2.1	Linear Equations; Integrating Factors	In-class activity 1: Slope fields due 2/4
	2.2	Separable Equations	
	2.3	Modeling with First Order Equations	
WEEK 3: 1/31—2/4	2.5	Autonomous Equations and Population Dynamics	In-class activity 2: Fixed points due 2/7
	2.7	Numerical Approximation; Euler's Method	
	Supplement	Learning enough MATLAB to to program Euler's method	Project 2: Slope fields, due 2/11
WEEK 4: 2/7 - 2/11	3.1	Homogeneous Equations with Constant Coefficients	
	3.2	Solutions of Linear Homogeneous Equations and the Wronskian	
WEEK 5: 2/14—2/18	3.3	Complex Roots of the Characteristic Equation	Project 3a: FOR loops, due 3/4
	3.4	Repeated Roots; Reduction of Order	
WEEK 6: 2/21—2/25	**Midterm Exam 1: Wednesday, February 23**		
	3.5	Nonhomogeneous Equations; Undetermined Coefficients	

	3.6	Variation of Parameters	Project 3: Euler's Method, due 3/11
WEEK 7: 2/28—3/4	3.7	Mechanical and Electrical Vibrations	
	3.8	Forced Vibrations	
WEEK 8: 3/7—3/11	6.1	Definition of the Laplace Transform	
	6.2	Laplace Transform Solution of Initial Value Problems	
Spring Recess: March 14-18			
WEEK 9: 3/21—3/25	6.3	Step Functions	
	6.4	ODEs with Discontinuous Forcing Functions	
WEEK 10: 3/28—4/1	6.5	Impulse Functions	
	6.6	The Convolution Integral	
	7.1	System of First Order ODEs	In-class activity 3: Phase planes, Due 4/8
WEEK 11: 4/4—4/8	7.2	Review of Matrices	
	7.3	Review of Linear Algebraic Equations, Eigenvalues, and Eigenvectors (2x2 Matrices)	In class activity 4: Linear systems, Due 4/18
WEEK 12: 4/11-4/15	**Midterm Exam 2: Wednesday, April 13**		
	7.4	Some Theory for Linear Systems of ODE (very briefly)	
	7.5	Homogeneous Linear Systems with Constant Coefficients	
	Supplement	SIR Modeling of Epidemics	Followup questions Due 4/22
WEEK 13: 4/18—4/22	7.6	Complex Eigenvalues	Project 4: Computing with the SIR Model Due 5/5

	10.1 + supplement	Two-Point Boundary Value Problems + Supplement	
WEEK 14: 4/25—4/29	10.2	Fourier Series	
	10.4 + supplement	Even and Odd Functions (plus PDF supplement on Fourier Series for BVP)	
WEEK 15: 5/2—5/3	REVIEW FOR FINAL EXAM		
FINAL EXAM PERIOD: May 6 - May 12, 2022			

Updated by Professor R. Goodman - 7/29/2021
Department of Mathematical Sciences Course Syllabus, Spring 2022